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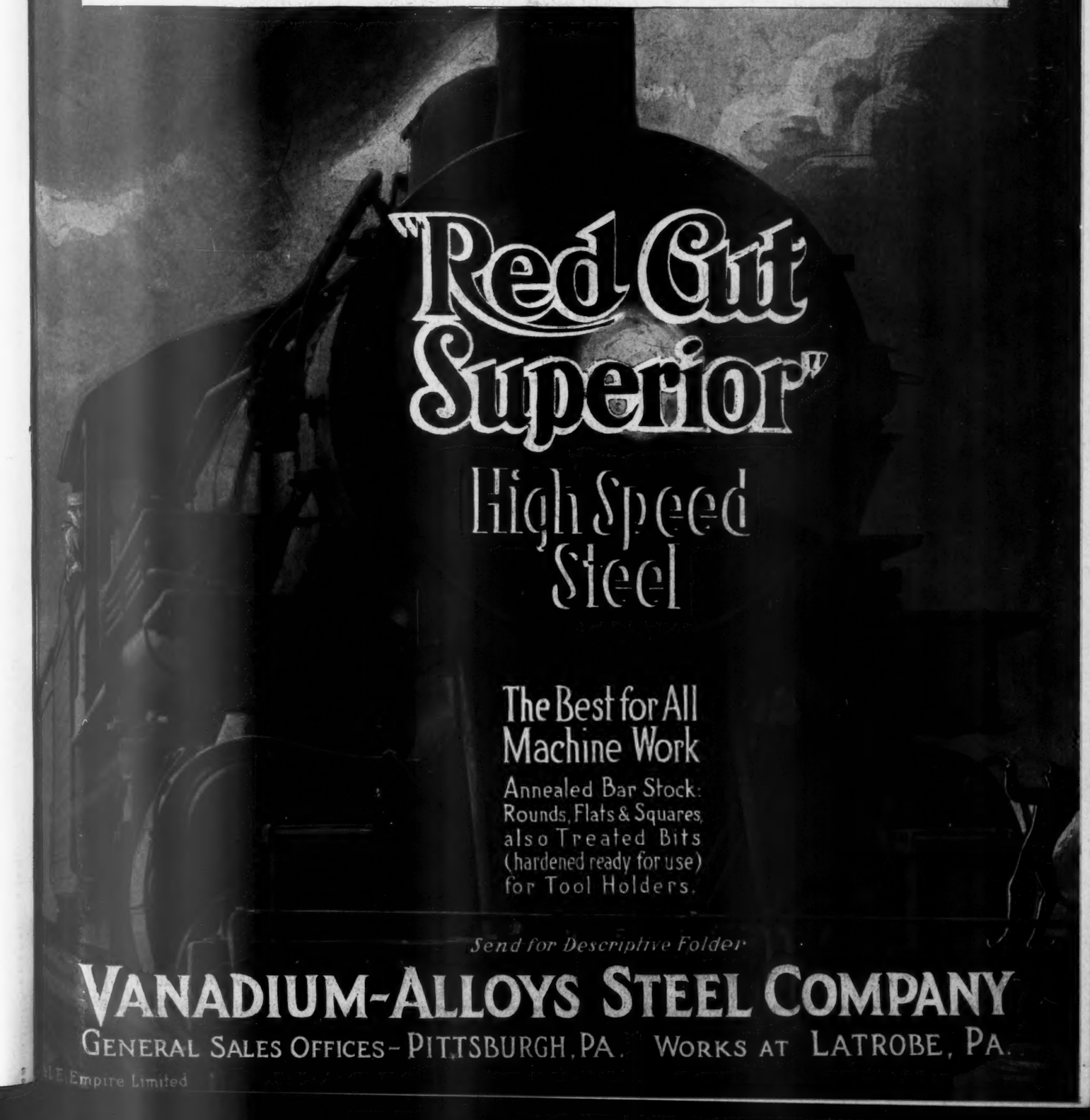
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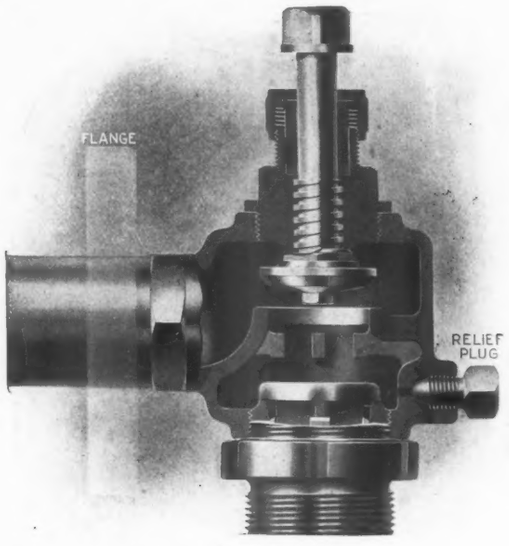

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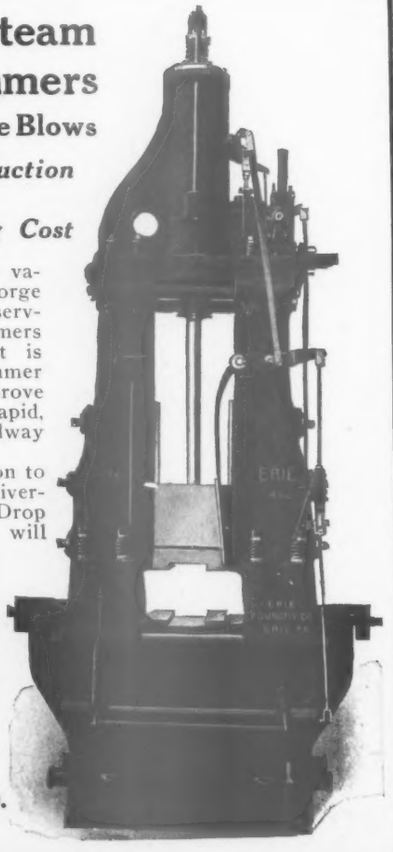

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Railway Mechanical Engineer

Volume 90 October, 1916 No. 10

Help Push Your Association

Last month we announced that prizes of $15 each would be awarded for the three best articles of not more than 750 words received at our office in the Woolworth Building, New York, not later than November 1, 1916, setting forth the practical benefits received by the writers from their attendance at the railway mechanical department conventions. The importance of the work done by these associations is most fully realized by those members who are actively engaged in association affairs, and here is an opportunity for them to show how well their interest and belief in these institutions is justified. Such testimony can not fail to interest others who should belong to the asso ciations, as well as the general officers upon whose support their success so largely depends. While there are but three prizes offered, we confidently expect to receive a large number of contributions nearly as good as the prize winners, which we will publish and pay for at our regular space rates. Be sure that your association is represented.

Fuel Cost and Fuel Economy

The high price of coal, or the distance it has to be hauled, does not necessarily mean that it is the most expensive coal to buy. With the constantly increasing improvement in the art of firing locomotives and in the economical use of fuel as a whole, new conditions have developed which may warrant the use of a more expensive fuel with a saving in the actual cost of the fuel consumed. This has been found to be true on one road in the Middle West which took the trouble to investigate. One division of the road had for some time been using a low grade coal that was mined in the territory through which the division ran. Further west there was a much better grade of coal which was more expensive and had to be hauled greater distances. However, experiments were made with the result that it was decided to use the better grade of coal from the distant point in preference to the local coal of inferior quality. This has been justified, for a saving of 20 per cent has been made in the cost of fuel consumed in the particular district where this change was made.

The Engine House and the Tool Foreman

It was a great satisfaction to hear various speakers at the Tool Foremen's Convention put in such a strong plea for the engine house forces. If there is one place in a railroad organization that needs all the assistance in the matter of good tools and special devices with which labor and repairs to locomotives may be expedited it is the engine house. The only thing a railroad has to sell is transportation. The cost of conducting this transportation is dependent on the condition and availability of the power. It is the duty of the engine house foremen to provide this power many times on sudden demand and to have it in such shape that it can handle its proper tonnage. Quick repairs are often necessary and the necessary means for making them should be provided. The tool foreman can be of great assistance in this respect. His work requires that he devise tools and, in many cases, equipment that will expedite the making of repairs. Being located at the larger shops he naturally gives their needs his first consideration, but he should not forget the running repairs which are so necessary to good locomotive performance. Most careful study should be given to engine house requirements and he should use his ingenuity in devising ways and means for expediting its work.

Standard Methods for Railway Shops

From the remarks of some of the tool foremen at their recent convention it appears that on several roads the interchange of ideas and of special shop devices between the various shops, even on the same road, is extremely limited. It is hard to conceive how a condition such as this should be allowed to exist. Any new device or method of performing economically a certain class of work originating at one point should be drawn up in suitable form and passed along to all the shops on the system for their immediate benefit. This is done usually by means of a book of blue prints and instructions. The Sante Fe has what is called a Locomotive Folio and a Tool Folio. The former covers standard practices—giving the scrapping limits of the various parts of the locomotive, methods, of making certain repairs, etc. The latter contains a description of the standard tools and special tools that are of sufficient merit to warrant their duplication at the other shops on the system. The Locomotive Folio is in charge of the mechanical engineer and the Tool Folio is in charge of the supervisor of tools. These folios are distributed broadcast over the system and their use is enforced. As improvements develop changes are made. Any and all suggestions for improvements are given careful consideration. Every part of the road receives full benefit of the ingenuity and achievements of any one part of the road. It is only by this means that the outlying points can be kept up-to-date in the most efficient shop practices.

Functions of the Mechanical Associations

W. J. Tollerton, in his address to the Master Blacksmiths' Convention, brought out clearly the functions of the various mechanical associations. Referring particularly to that association, he said: "It would be of enormous benefit to all railroads if this association would formulate some kind of a standardized schedule of blacksmith shop practice." This statement may well apply to all the other associations representing the various shop crafts. Several roads have already established standard shop methods in making repairs to cars and locomotives which represent the best methods known to those roads. Why not carry it further and have the various associations thoroughly study shop practices peculiar to their specific fields and form standards that will be the best established standards in existence? The associations could not use their time to better advantage. They would be performing a real service to the

roads they represent. It would be a great thing for each association to have a set of established standards and recommend practices the same as the Master Car Builders' and Master Mechanics' Associations. These could be added to and corrected year by year and be kept up to date with the development in the various fields. With the labor conditions such as they are at present anything that will increase shop efficiency will be gladly welcomed. If the mechanical associations would spend their time in establishing standard practices they would undoubtedly receive far greater support from railroads than they do now. It would be a matter of business to have a representative from every important road attend the conventions in order that the best possible results might be obtained.

The Microscope and Boiler Steel

Is the microscope too refined for use in connection with the selection of boiler steel? Can it be used with safety by the man who has not had years of training in its manipulation and in drawing conclusions from its indications? To both of these questions an affirmative answer can probably be made with safety. If the observer desires to determine an approximation of the carbon content of a piece of steel, it is probable that, unless he has had considerable training, he will vary so far from the true mark that he had best discard his microscope and betake himself to the chemist. But for the detection of defects in the material, such as the inclusion of slag, minute blow-holes, and variation in structure the microscope will tell a story to even a lay operator that can be told in no other way. An article in the Railway Age Gazette of April 28, 1916, page 960, gave a vivid example of how a piece of steel, that had passed all inspection and was presumably of a high grade, was shown by the microscope to be really unfit for the service to which it had been applied, simply because of the great variation in its structure between surface and center, that could have been detected in no other way.

The preparation of the specimens is exceedingly simple and an instrument with glasses arranged magnifying from 20 to 100 diameters will serve all the purposes of a quick and accurate means of determining the general structural character of a piece of steel or iron. It will frequently make it possible to decide at once in the choice of two brands and the probable relative results to be obtained from them. It tells a very vivid story of structure and enclosed impurities that can be read in no other way, and to those who are shown it without previous knowledge of what they are to see the indications are usually quite startling.

General Foremen and the Car Department

Notwithstanding the seriousness of the strike situation, the attendance at the convention of the International Railway General Foremen's Association at Chicago during the last week in August was good. It became necessary, however, to set the adjournment one day ahead, the result being that a number of the subjects were not discussed as fully as their importance and the character of the papers presented would have justified under other circumstances. It is significant, however, that the subject which brought out probably the fullest discussion of any presented, was that of car department problems. At the smaller terminals the general foreman in charge of locomotive maintenance often has direct supervision over car repair work but to a large extent the members of the association are directly concerned with locomotive work only. It is from the ranks of these men, however, that the higher mechanical department officers are usually selected; and as soon as he is promoted to the position of master mechanic, the general foreman is immediately called upon to deal with car department matters. From the standpoint of the ambitious general foreman, therefore, it is to his own interest that he keep as closely in touch with the car department and cooperate with the car foreman to the fullest possible extent. That this is the attitude of the members of the association was well brought out in the discussion, but the interest thus displayed in the car department will be of much wider benefit than that gained by the individual. The general officers of the mechanical department are, and probably will continue to be, chosen largely from the ranks of the locomotive department. Improvements in the car department service, therefore, very largely must depend upon the broad appreciation of its problems and of the importance of the work which it performs by the future master mechanics and superintendents of motive power.

The Purchase of Paint On Specifications

The advisability of purchasing paint on specifications has been seriously questioned by many users of paint and there is a growing doubt as to whether the quality of the materials thus obtained is not inferior to those obtained by straightforward purchase of the guaranteed products of reputable paint manufacturers. That the experience of the manufacturers qualifies them to provide a product suitable to meet the conditions of any class of service is undoubtedly true, and that the reputation which the manufacturers have to maintain, is generally a sufficient guarantee that their products will honestly meet the conditions, is no less true. Specifications would appear to be unnecessary then, to secure a suitable product, and their principal function is to secure the product desired under competitive conditions, with the saving in price which is effected thereby. In order that a product of the quality desired may be secured under open competition, it is not only necessary that the specifications be carefully drawn and well advised, but that the purchaser be in a position to enforce their provisions. The success with which specifications may be employed where these requirements can be met, was well brought out in the remarks of Dr. M. E. McDonnell, chemist of the Pennsylvania Railroad, before the recent convention of the Master Car and Locomotive Painters' Association, the report of which appears elsewhere in this issue. But few railroads, however, are provided with the facilities available on the Pennsylvania for making the numerous tests necessary in the development and enforcement of adequate specifications, and the extent to which they can safely and successfully be employed undoubtedly depends in a large measure upon the extent to which facilities of this kind are available. Specifications employed without some such facilities tend to defeat their own end; while products may thereby be obtained at a low price, the quality will usually be such that the paint is expensive in the end.

Corrosion and Boiler Steel

The electrolytic theory of corrosion, as developed and proved by Dr. Allerton Cushman, so fully accounts for all the various phenomena attendant upon the corrosion of iron and steel that it is accepted throughout the scientific world. But theories of this character are too often regarded as pure theories by the practical men of affairs—something belonging to the laboratory and the domain of scientific investigation and as having little or no connection with the work of every day life, or at best to be possessed of such a refinement as to have little or no influence upon them. In short, there is a decided mental distinction drawn between the action of a piece of steel subjected to the delicate tests of a laboratory experiment and the performance of a similar piece in the rough service that it has to perform in the firebox of a locomotive. That this is a mistake, almost anyone will

concede. And because this matter of corrosion is one of the serious troubles of locomotive boiler maintenance it is urged that too much attention cannot be paid to the selection of steels that are used therein. The whole electrolytic theory of corrosion is based upon the development of electric currents by the non-homogeneous character of the metal, and the greater this variation in structure and composition the more rapid will be the corrosion. This is a simple statement of cause and effect. Hence it follows that he who would suffer the minimum of trouble from corrosion must pay the maximum of attention to the selection of his steel and iron, other conditions remaining the same. This is not to assume that the sole precaution to be taken against corrosion lies in the selection of the steel, for there is such a thing as a corrosive water, but, as Kipling would say, that is another story.

Proper Braking of Long Passenger Trains

The apparently increasing difficulties experienced by the railways in properly braking the long heavy passenger trains in service today is due very largely to the fact that sufficient attention has not been given to the foundation gear of the modern equipment. With the heavier steel passenger cars greater shocks result for the same difference in velocity between the front and rear cars of a train than when the lighter wooden passenger cars were used. These shocks are further increased on account of the longer trains now being handled in the present through-train service. Of course, the braking power has been increased to meet these new conditions, and the difference in time between the application of the brakes on the first car and on the last car has been decreased through quicker acting triple valves. But the adoption of the improved foundation gear has not been so general.

With the single shoe brake it is practically impossible to keep a uniform brake cylinder piston travel throughout the train, which means unequal braking of the cars with the attendant shocks throughout the train. The manner in which the shoes are located with respect to the wheels is largely responsible for this. They must be located sufficiently far below the horizontal center line of the wheel to bring the resultant pressure line of the shoe against the wheel within the journal brass. In this position the shoe has a tendency to pull down under the wheel, increasing the false travel of the brake rigging. As this travel is taken up by the automatic slack adjuster the brake cylinder piston travel becomes shortened, resulting in increased brake shoe pressure with small brake pipe reductions. This is cumulative and near the end of long runs the engineer has extreme difficulty in applying the brakes so that a smooth and quick stop can be made. He is forced to make two or three light reductions in an endeavor to obtain a smooth stop, which means that more time must be taken in making stops.

The experience of the New Haven and the Pennsylvania with the clasp brakes has shown that by their use the troubles found in handling the long heavy passenger trains with the single shoe brake have been practically eliminated. With the clasp brake less pressure per shoe is required, the shoes can be applied nearer the horizontal center line of the wheel, the truck frame will be subjected to a smaller amount of racking and displacement and there will be practically no false motion for the automatic slack adjuster to take up. This permits the slack adjuster to do the work intended for it—namely, to take up the lost motion due to the wear of the shoes. While the clasp brake has been adopted to some extent on four-wheel trucks its particular field is on the six-wheel truck cars weighing from 120,000 to 160,000 lb. Its satisfactory application requires an 11-ft. wheel base, and car designers, even though they cannot see the need of the clasp brake to their equipment now, would do well to adopt this length of wheel base in case it becomes advisable to change to the clasp brake in the future.

Speed Indicators on Locomotives

The use of speed recorders on locomotives has been given but little attention in this country, and then only as applied to road engines. This is remarkable, considering the possibilities for improvement, both in operation and maintenance, which the records from these instruments open up in switching service as well as in road service. Where locomotives are shopped on a mileage basis, the usual method of computing the mileage of switch engines is by the allowance of an arbitrary number of miles for each hour the engines are in service. This is at best but an approximation, the variation of the actual mileage from which will be considerable, depending on the conditions under which the engines are working. That the discrepancy between the miles credited to the engines and the actual service rendered may be very great was brought out in the discussion of the report on Classification of Repairs at the convention of the General Foremen's Association. On the El Paso & Southwestern, where the engines were credited with 72 miles per day, after they had been equipped with speed recorders the actual mileage was found to be from two to three times this amount. It is needless to say that this condition had been a source of considerable discord, as the mechanical department foremen were expected to keep the engines in service from two to three times as long as they could reasonably be expected to run—often an impossible task.

In road service the speed recorder is a necessity where maximum speed limits are in force, but their usefulness does not end with the performance of this function. The records, which are in effect logs of the trips made by the locomotive, are a valuable source of information in settling controversies growing out of train delays, the mechanical department being relieved of the burden of proof in many cases which rightfully should be charged to the operating department. Their influence is also felt in running repairs. On the El Paso & Southwestern in the maintenance of driving boxes alone, they have effected a material saving, by insuring that the maximum speed limit specified will not be exceeded, it having been possible at one terminal to materially decrease the number of men in the drop pit gang. The possibilities in this regard may readily be seen, as inequalities in time card schedules often cause the speed required at certain points on the line to be unnecessarily high, while the running time on other portions of the line could be shortened. Inequalities of this kind are readily brought out by the records from the speed recorders, making possible the adjustment of schedules more accurately to meet the operation conditions and thereby reducing the wear and tear on the motive power. All of these benefits have actually been derived from the speed recorders where they have been in service in this country.

NEW BOOKS

Proceedings of the Tenth Annual Convention of the Master Boiler Makers' Association. 200 pages, illustrated, 6 in. by 9 in. Bound in cloth. Published by the secretary, Harry D. Vought, 95 Liberty street, New York City. Price, $1.

This volume contains a complete transcript of the proceedings of the convention of the association, which was held at the Hotel Hollenden, Cleveland, Ohio, May 23 to May 26, 1916. The association is to be congratulated upon the short time which has elapsed between the holding of the convention and the publication of the complete proceedings in book form.

BOILER EXPANSION EXPERIMENTS*

Tests to Determine Relative Movements of Firebox Sheets and Tubes Under Working Conditions

BY D. R. MAC BAIN
Superintendent Motive Power, New York Central West, Cleveland, Ohio

SOME experiments were made on the New York Central in 1910 to determine why the side sheets of certain new fireboxes would crack vertically between the staybolt holes. In one case it was found necessary to put in new sheets on a new boiler that had been in service only about four months. Mr. Linderman, then boiler maker on the Michigan Central, conceived the idea of comparing the expansion of the inside sheets and the outside sheets for various conditions of heat and pressure. A boiler exactly similar to the one that failed was taken for the experiment. Tram marks were made on the inner and outside sheets when the boiler was cold. The engine was then fired up and after 200 lb. pressure had been raised and the pops had been blowing for some time, the fire was quickly dumped and the measurements between the tram marks taken on both the inside and outside. It was found that the outside sheet expanded 3/32 in. more than the inside sheet.

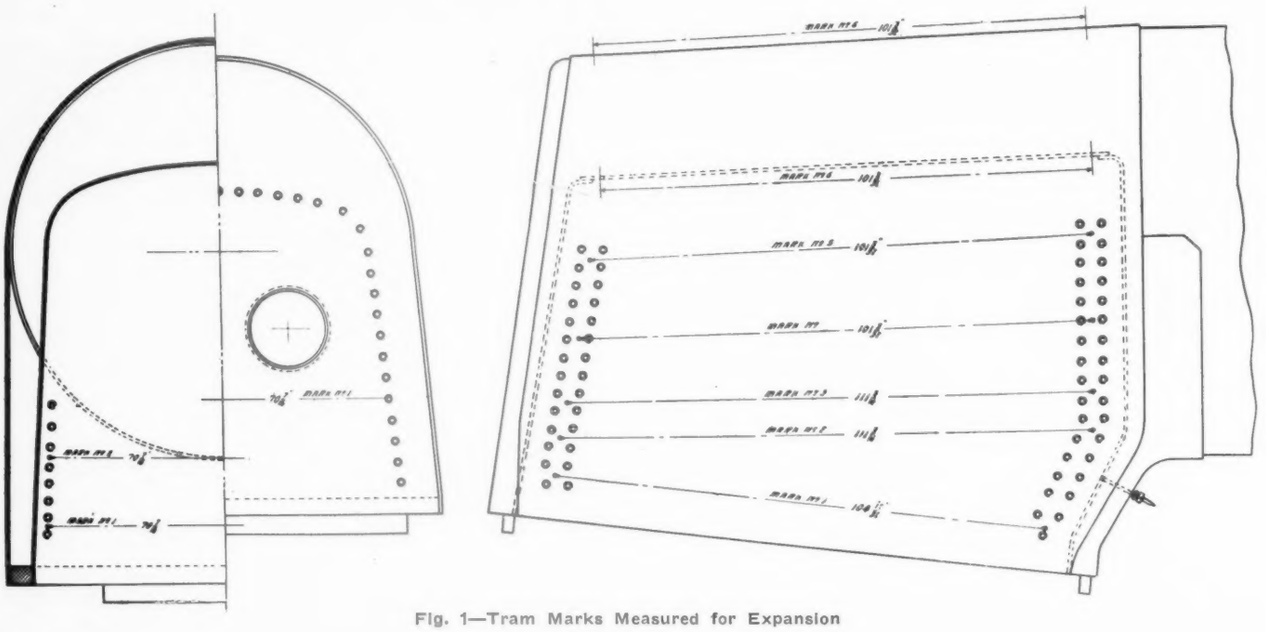


Fig. 1—Tram Marks Measured for Expansion

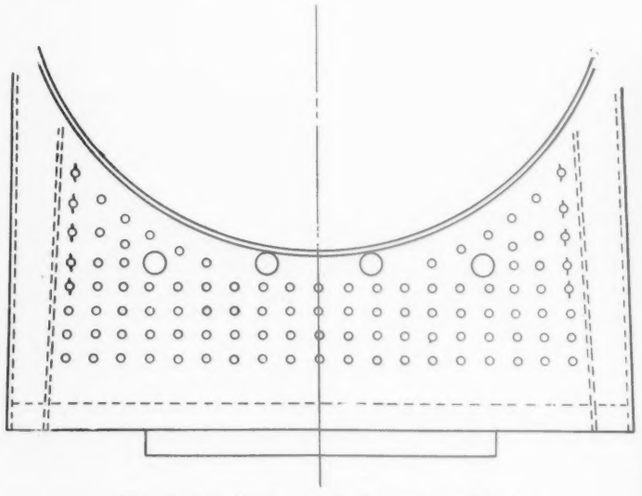


Fig. 2—Cracks Found in the Throat Sheet

This same experiment was again tried under more favorable conditions at the West Albany shops, a wide firebox boiler being used. Six sets of tram marks were made on both the inside and outside of the boiler, as shown in Fig. 1, the

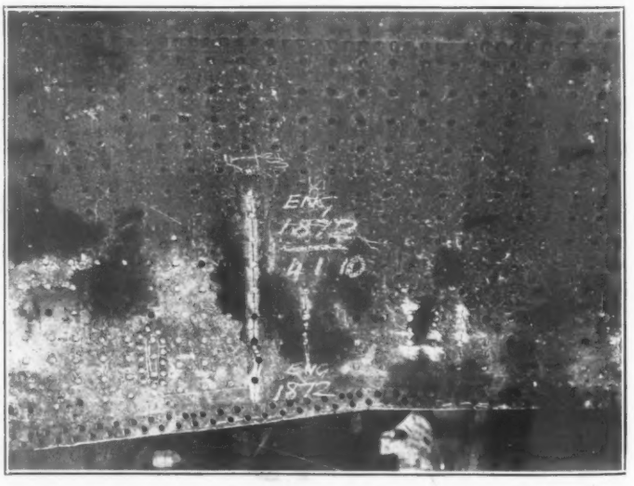


Fig. 3—Showing the Staybolt Cracks in the Side Sheets

*Abstract of a paper presented before the Western Railway Club, April 18, 1916.

sixth one being made in the crown sheet and the roof sheet. The same procedure was followed as in the previous test, and here again it was shown that the expansion of the outer sheet was greater in every case than that of the inner sheet. The following table shows the results of these tests:

Mark No.	Outside Wrapper Sheet Location	Outside Wrapper Sheet Expansion	Inside of Firebox Location	Inside of Firebox Expansion	Difference in Expansion
1	Side Sheet	3/16 in.	Side Sheet	1/8 in.	1/16 in.
2	Side Sheet	5/32 in.	Side Sheet	3/32 in.	1/16 in.
3	Side Sheet	1/4 in.	Side Sheet	5/32 in.	3/32 in.
4	Side Sheet	3/16 in.	Side Sheet	1/8 in.	1/16 in.
5	Side Sheet	7/32 in.	Side Sheet	1/8 in.	3/32 in.
6	Wagon Top	7/32 in.	Crown Sheet	5/32 in.	1/16 in.
1	Throat Sheet	5/32 in.	Tube Sheet	7/64 in.	3/64 in.
2	Throat Sheet	3/16 in.	Tube Sheet	1/8 in.	1/16 in.

This would seem to account for the breakage of the back head and throat sheets along the outer row of staybolts, also for the vertical cracks in the side sheets, as well as the cracks extending from the arch tube holes (see Figs. 2 and 3). It was also found by means of a needle connected to the inner throat sheet and passing through the outer throat sheet, as indicated in Fig. 1, that the inner tube sheet moved outward 3/32 in. when the fire was first started and before the circulation was fully established, and later when steam pressure began to rise, backward about 1/16 in. The first movement of the needle throws some light on the cause of the side sheet popping out along the fire line as they sometimes do.

At the left in Fig. 4 is shown an installation of flexible staybolts which, when adjusted as shown by the table underneath the illustration, will relieve the stresses that cause the vertical cracks between the outer row of staybolts in the back head of the boiler. On the right in Fig 4 is shown an installation of flexible staybolts which, with the method of adjustment indicated, will relieve the stresses which are responsible for the cracked side sheets and cracked throat sheets. Both the New York Central and the Michigan Central have followed this plan with excellent results—and in addition apply a full installation of flexible staybolts in the throat sheets, the first row above the mud rings being set tight, the second row 1/32 in. loose, and all others 1/16 in. loose. The back tube sheet braces are set 3/32 in. loose. It is believed this practice will increase the life of a modern firebox from 50 to 75 per cent. The loose installation of these flexible staybolts is considered necessary in order to avoid excessive staybolt and tube sheet breakages. At the same time it will

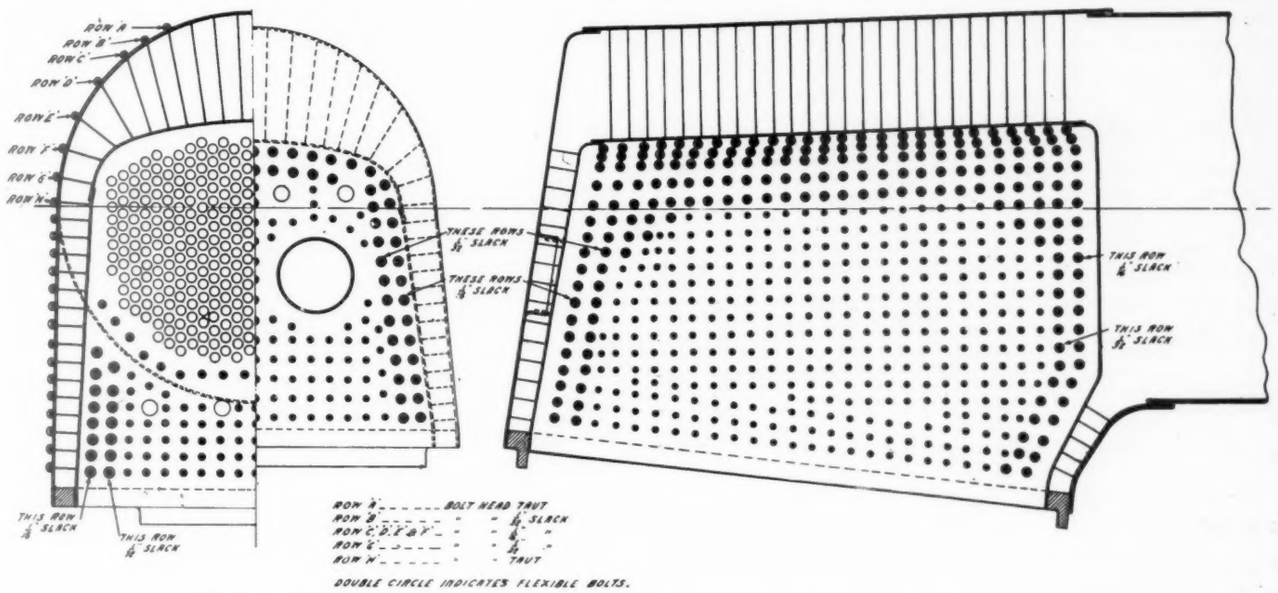

ROW A
ROW B
ROW C
ROW D
ROW E
ROW F
ROW G
ROW H
THESE ROWS 1/8 SLACK
THESE ROWS 1/8 SLACK
THIS ROW 1/8 SLACK
THIS ROW 1/8 SLACK
THIS ROW 1/8 SLACK
THIS ROW 1/8 SLACK
ROW A ——— BOLT HEAD TAUT
ROW B ——— " " 1/8 SLACK
ROW C D E F ——— " " 1/8 " "
ROW G ——— " " 1/8 " "
ROW H ——— " " TAUT
DOUBLE CIRCLE INDICATES FLEXIBLE BOLTS.

Fig. 4—Application of Flexible Staybolts to Relieve Working Stresses in Locomotive Fireboxes

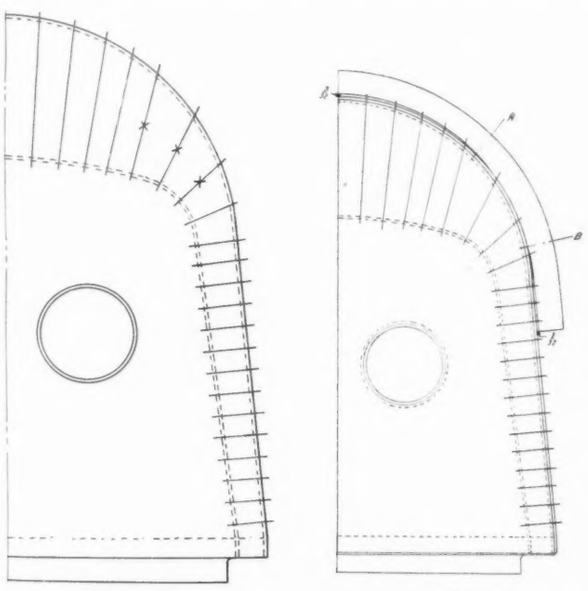


Fig. 5

Fig. 6

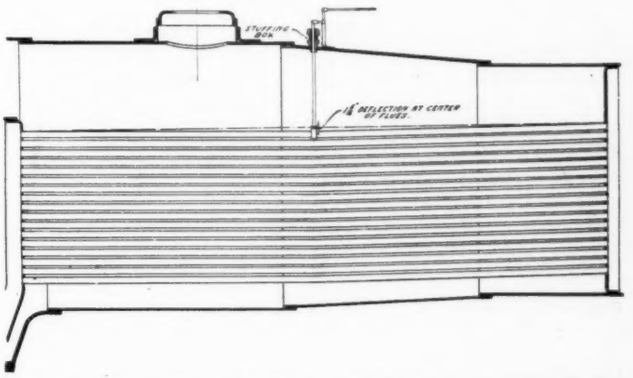


Fig. 7—Arrangement of Pointer in Boiler Tube Deflecting Test

reduce the strain on the arch tube anchorages and eliminate quite a source of trouble.

In February, 1907, a full installation of flexible staybolts was made on an Atlantic type engine when this engine received a new firebox. They were of the Tate flexible type, with the exception of four bolts directly under the safety valve dome, and four under the steam turret, also eight bolts which go on the top seam of the back head, which were sling stays. From the time this installation was made to October, 1915, when a superheater was applied and the side, tube and door sheets were renewed, this engine made over 500,000 miles without a flexible staybolt failure. During this time the engine was shopped for general repairs five times, the old tube sheet was patched three times and one new tube sheet applied, the mud ring corners were patched three times and the right side sheet patched once.

Another source of trouble was found with the breakage

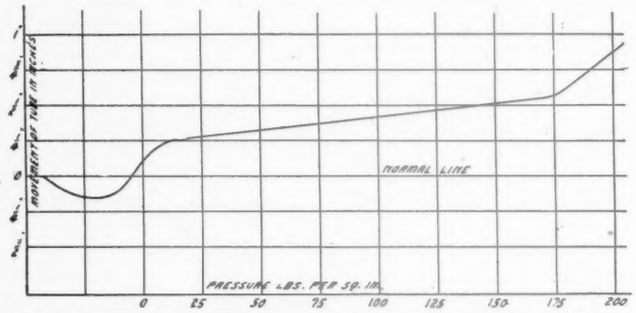


Fig. 8—Curve Showing Movement of Tube; Boiler Fired Up Without Blower

of the staybolts, indicated by *X* in Fig. 5, in some of the wide firebox engines. We believed that the cause of these bolts breaking was the same as that which was responsible for the leaky side sheet seams, and further, that the elimination of excessive staybolt breakage would result in a cure for these leaky seams. When these locomotives were built, rigid bolts were applied in these rows, and it was quite common to find anywhere from 3 to 5 or more bolts broken. An experiment was tried on an engine of this type which was in the West Albany shop for general repairs, by Mr. Linderman, who was at that time supervisor of boilers. A heavy

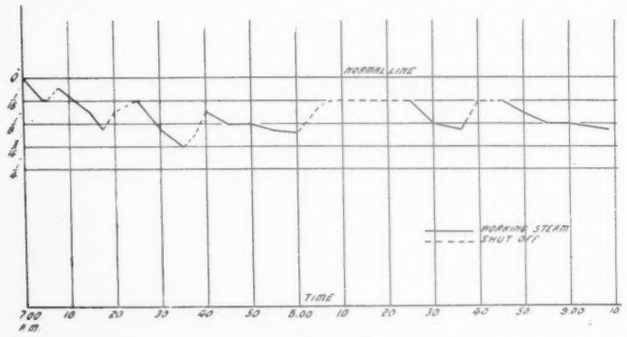


Fig. 9—Curve Showing Movement of Tube in Road Service, West Albany to Rotterdam Jct.

templet was fitted over the side of the boiler, as shown in Fig. 6, when the boiler was cold. It was firmly clamped at its center to the boiler. The fit was very carefully made, a man working nearly a week to have it absolutely accurate. The engine was then fired up and the effect of heating up the boiler to the point where 200 lb. of steam was obtained caused the wrapper sheet to bulge out so that there was 3/32 in. opening between the templet and the wrapper sheet at both ends of the templet. This, it seems, explained the cause of these staybolts breaking. In order to determine whether this distortion of the boiler was caused by the pressure or the heat, the templet was carefully refitted and a pressure of 225 lb. of cold water put on the boiler. The templet retained its seat, which proved conclusively that the distortion was due to the temperature and not to the pressure. The application of three rows of flexible staybolts with 1/32 in., 1/16 in.

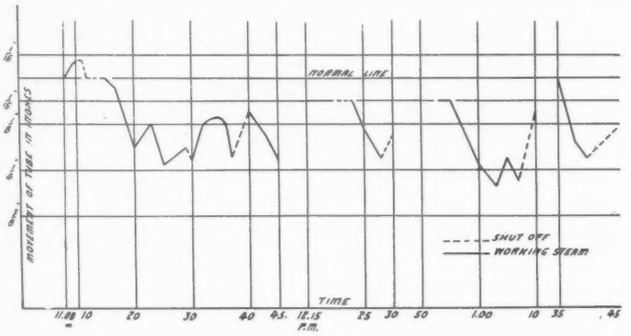


Fig. 10—Curve Showing Movement of Tube in Road Service, Utica to Palatine Bridge

and 1/32 in. slack, respectively, stopped the trouble and cured the trouble from leaky seams.

The New York Central has also made experiments to determine why the back and front tube sheets become deflected or distorted. It was believed that while the boiler was working and had a hot fire the circulation of the water being good the expansion in the boiler proper, that is between the tube sheets, was greater than in the tubes. An experimental set of tubes was installed in a large Pacific type locomotive, each tube being given a drop of 1 5/16 in. at the center before it

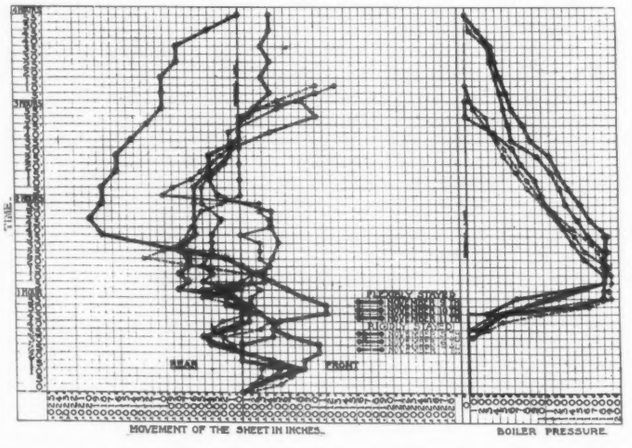


Fig. 11—Relative Movement of Back Tube Sheet to Throat Sheet

was fastened at each end. The work was under the direction of Mr. Linderman. A rod was fastened to one of the top tubes at the center and extended up through a stuffing box in the boiler shell, as shown in Fig. 7, the outer end being attached to a recording device which would register the movement of the tube. Fig. 8 gives the result of a standing test from the time the fire was started until 200 lb. pressure in the boiler was obtained. It will be noted that almost immediately after the fire was started the tube deflected still more until it had reached 1/8 in. It remained in this position for a short time and then it raised and was about 1/8 in. above the normal position when the steam pressure began to rise. It rose gradually until 175 lb. pressure was obtained, and then rose rather abruptly. This rapid rise cannot be accounted for unless it might be that the needle did not work in the stuffing box quite as freely as it should, although the packing in the stuffing box was very loose.

Following this test, road tests were made under the direction of Mr. Linderman and Mr. McPartland, the latter an engineer of long experience in testing locomotives and their appliances. Fig. 9 is the record made by the recording device on the first road trip, which was from West Albany to

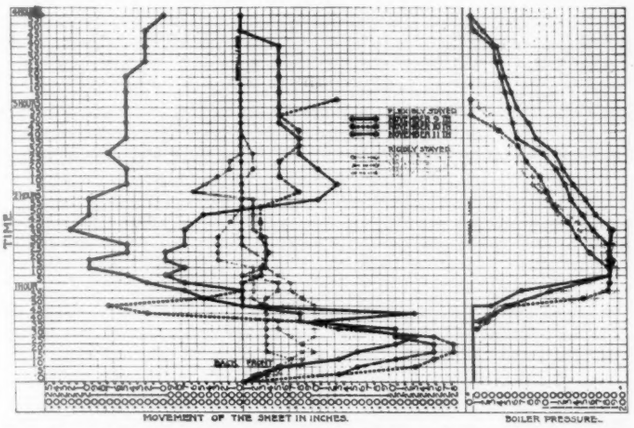


Fig. 12—Relative Movement of Back Firebox Sheet to Back Boiler Head

Rotterdam Junction. The solid lines in this diagram are readings taken when the throttle was open, and the dotted lines when the throttle was closed and while the engine was drifting. It will be noted that immediately upon starting the tubes began to deflect, and that they would rise when the engine was not working steam. The maximum deflection was 3/16 in., this point having been reached while the engine was being worked hard and running at a good speed.

Fig. 10 is the record in the second road test, which was made from Utica to Palatine Bridge. The rise of 1/16 in. above the normal line at the start of the trip cannot be ex-

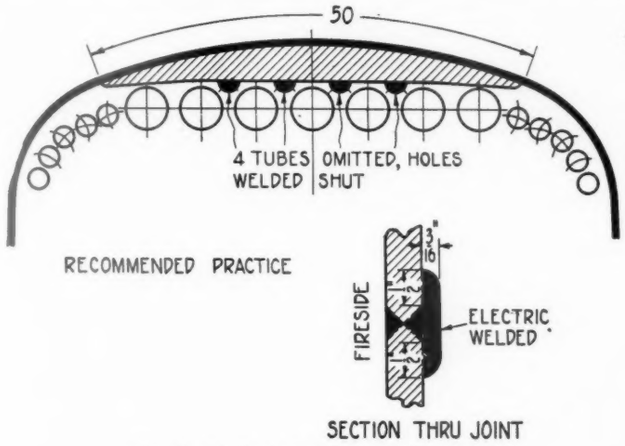


Fig. 13—Method of Patching Tube Sheet

plained, but it will be noted that it did not occur again on the trip. The balance of the record is very nearly a repetition of what occurred on the first trip, the increase in the deflection in the tube being, in our opinion, due to the fact that the engineer on this trip worked the engine harder than did the engineer on the first trip. The maximum deflection was 5/16 in. The break in this diagram indicates periods during which the apparatus was cut out while switching was being done. The line at the right of the card, which shows the tube back in its normal position, followed quite a long stop at a station.

We have also had some trouble with the staybolts in the throat sheets. On certain of the large locomotives which were purchased with a full installation of rigid staybolts a great number of these bolts were found broken or fractured about four or five months after the engine had been placed in service. The cure that was applied in this case was the complete installation of flexible staybolts over the whole throat sheet. It was also found that the braces between the tube sheets and the boiler shell at the throat sheet would become broken. This has been overcome by putting on the belly braces with a 1/16-in. slack under the nut at the crowfoot on the belly of the boiler. This is usually done by first pulling up one nut tight, backing it off 1/16 in. and then setting the jamb nut. These braces seldom, if ever, break, nor do they pull the rivets off the fire side of the tube sheet. It is the standard practice on the New York Central at the present time.

An investigation was also made to determine the direction and extent of expansion in a tube sheet resulting from prossering a set of new tubes. A circle of as large diameter as possible was described on the tube sheet before the tubes were set. After the tubes had been set it was found that this circle had increased, or had widened out 1/32 in. at the sides and bottom, and 3/32 in. at the top. When it is considered that we were at that time prossering the tubes at least once every 30 days, it will be readily understood why the flange at the front end of the crown sheet is deformed. It has been our experience that the 3-in. radius for the tube sheet flange will give better results than the 2-in. radius.

Fig. 11 is a diagram indicating the relative movements of the back tube sheet to the throat sheet from the time the boiler is heated up and raised to 200-lb. pressure and released back to zero pressure. Two engines of exactly the same type were tested, one having all flexible staybolts, and the other all rigid staybolts. The light lines indicate the sheet movement on the rigidly stayed boiler, and the heavy lines that of the flexible stayed boiler. Three sets of tests were made with each boiler. This shows pretty plainly that there is a necessity for some freedom of the sheets longitudinally in order to avoid excessive strains being set up.

Fig. 12 shows the relative movement of the back fire box sheet and the back boiler head. Fig. 13 shows the process recommended for patching the top of a tube sheet that had been cracked from the top of the tube holes up to the flange. The patch is welded in and reinforced by a rib on the water side as shown in the cross section, and it is believed that it is as strong as the original sheet was before the beginning of the cracks. For a horizontal crack around the flange of the tube sheet a first-class job can be made without patching by simply welding, as shown in the cross section.

PULVERIZED FUEL FOR STATIONARY BOILERS ON THE MISSOURI, KANSAS & TEXAS

During the winter of 1912, when the natural gas supply was limited in quantity and fuel oil hard to obtain in Kansas, the officers of the Missouri, Kansas & Texas decided to investigate other methods for generating steam in the boilers at the powerhouse of the shops at Parsons, Kan. There were at this point, eight 250-hp. boilers of the Heine water tube type, equipped for using natural gas and oil as fuel. Some of the other fuels available in the district, which would be within an economical range as to cost delivered at the plant, were soft coals from the Mineral mine in Kansas, the McAlester and Lehigh mines in Oklahoma, and lignite from Texas, with the following analyses:

Kind of coal	Fixed carbon	Volatile	Ash	Moisture	B. t. u.
Mineral	45.22	26.39	20.38	8.01	10,640
McAlester	47.07	32.37	14.29	6.27	11,837
Lehigh	41.40	31.28	19.29	8.03	11,200
Lignite	25.50	33.95	7.58	32.97	7,548

The sulphur, separately determined, ranged from approximately 3 to 5 per cent in the various soft coals.

Owing to the ash and moisture content of these fuels, it was determined to investigate methods of using them in pul-

verized form, as it was known that pulverized bituminous coal has been in successful use in the cement industry, in a major portion of the plants throughout the country. This investigation resulted in the placing of a contract for the necessary equipment at the Parsons power house with the Fuller Engineering Company, Allentown, Pa., and the material and machinery were delivered in the fall of 1913. Owing to financial conditions, it was thought unwise to make the change at that time, but in the early part of 1916, owing to the abnormal price of fuel oil, orders were given to proceed with the work. The equipment was installed and the plant was placed in successful operation on August 1, 1916.

The equipment for pulverizing and drying fuel is contained in a separate building, which is located near one end of the boiler house and the coal is dumped from the cars directly into a concrete track hopper of 50 tons capacity adjoining this building. The plant is designed to handle either mine run or slack coal and immediately below the track hopper is placed a set of 24-in. by 20-in. Jeffrey double spike-tooth rolls, which will reduce lumps up to 12 in. by 18 in. to 5-in. cubes or less in one operation. As the coal passes through this crusher, it drops onto a 20-in. inclined belt conveyor, which discharges directly into a set of Lehigh 24-in. by 18-in. corrugated rolls. The upper end of the belt conveyor passes over a 24-in. by 22-in. Cutler-Hammer magnetic separator pulley, the function of which is to remove any pieces of iron or steel which may be in the coal and retain them on the belt until the latter passes off the underside of the pulley, the metal then dropping to the floor behind the crusher. This crusher reduces the coal to pass through a ¾-in. mesh or less and delivers it into a dust-tight elevator, from which it is distributed by a 12-in. screw conveyor into a storage bin of 50 tons capacity over the coal dryer.

The equipment throughout the pulverizer plant is operated by Westinghouse three-phase, 60-cycle motors at 440 volts. The first crusher is driven by a 10-hp. belt connected motor, while the inclined belt conveyor and the second crusher are operated by one 15-hp. belt connected motor, this arrangement obviating any possibility of choking the crusher. The elevator and screw conveyor by means of which the coal is taken from the rolls and delivered to the storage bin are operated by one 10-hp. back-geared induction motor.

Coal may be drawn from any part of the storage bin and delivered by means of a screw conveyor to the Fuller Engineering Company's indirect fired dryer, a chute from the conveyor being provided for the delivery of coal to the floor for firing the dryer furnace. The dryer is driven by a 10-hp. induction motor and will evaporate the moisture from coal containing 10 per cent moisture, to ½ per cent at the rate of eight tons per hour. In order that lignite, containing from 30 to 50 per cent moisture may be handled, the dryer is arranged so that the material may be passed through as many times as may be necessary to reduce the moisture to the desired maximum before the coal is delivered to the pulverizer.

From the dryer the coal is discharged directly into a second dust-tight elevator, delivering to a 12-in. screw conveyor, both of which are driven by a 10-hp. back-geared induction motor. The conveyor discharges the fuel

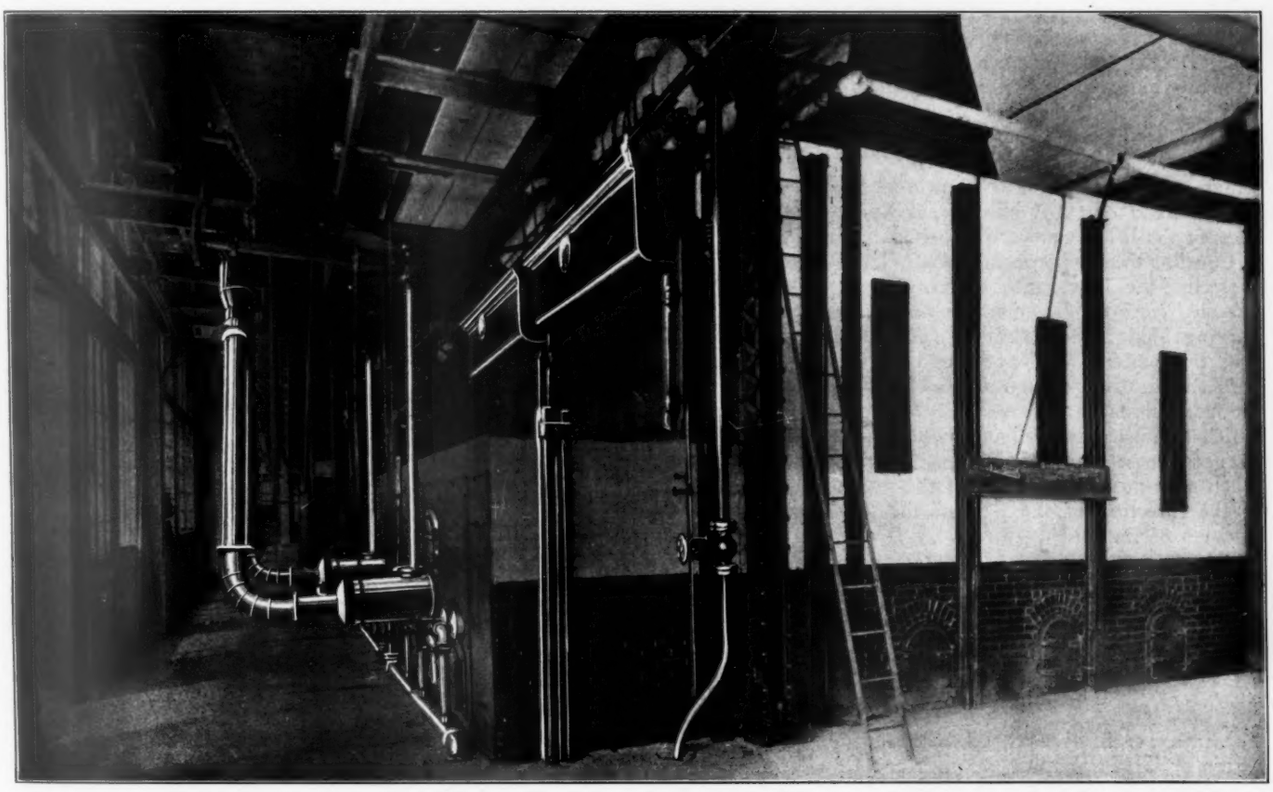
Fuller-Lehigh 42-in. Pulverizer Mills at the Parsons Plant

into two bins of 40 tons capacity each, which feed two four-inch Fuller-Lehigh pulverizing mills. The material to be reduced is fed to the mill by means of a feeder mounted on top of the mill. This feeder is driven direct from the mill shaft by means of a belt running on a pair of three-step cones, which permits the operator to accommodate the amount of material entering the mill to the nature of the material being pulverized. In addition, the hopper of the feeder is provided with a slide, which permits the operator to increase or decrease the amount of material entering the feeder hopper.

The pulverizing element of the mill consists of four unattached steel balls which roll in a stationary, horizontal concave grinding ring. The balls are propelled around the grinding ring by means of four pushers attached to four equidistant horizontal arms forming a portion of the yoke, which is keyed direct to the mill shaft. The material discharged by the feeder falls between the balls and the grinding ring in a uniform, continuous stream, and is reduced to the desired fineness in one operation. Fan discharge mills are fitted with two fans; one of these fans operates in the separating chamber immediately above the pulverizing zone, whereas the other fan operates in the fan housing immediately below the pulverizing zone. The upper fan lifts the fine particles of pulverized material from the grinding zone into the chamber above the grinding zone, where they are held in suspension. The lower fan acts as an exhauster and draws the finely divided particles through the finishing screen which completely encircles the separating chamber. The material leaving the separating chamber is drawn into the lower fan housing, from which it is discharged by means of the action of the lower fan. All the material discharged is the finished product which requires no subsequent screening.

The current of air induced by the action of the lower or discharge fan passes over the pulverizing zone and out through the screen surrounding the separating chamber, thus insuring cooler operation and maximum screening efficiency. This current of air keeps the screen clean and enables the mill to handle material containing a considerable amount of moisture without affecting the efficiency of the machine. As soon as the material is reduced to the desired fineness, it is lifted out of the pulverizing zone and discharged. Each pulverized is belt driven by a 60-hp. vertical motor and reduces the fuel so that 95 per cent of it will pass through a 100 mesh screen and 85 per cent through a 200 mesh screen, at the rate of four tons per hour, the plant having a maximum capacity of eight tons per hour.

The grouping of the drives for the various parts of the equipment makes possible a maximum utilization of the power consumed, as only such parts of the plant as are in actual use need be running at any time. When fully loaded the actual power consumed is within about five per cent of the rating of the motors, according to observations taken since the plant has been in service.



Heine Type, Horizontal Tubular Boilers Burning Pulverized Fuel, at the Parsons, Kan., Shops of the Missouri, Kansas & Texas

As the fuel leaves the pulverizer, it is discharged into a third dust-tight elevator and delivered to a 12-in. screw conveyor for transfer to the bins in front of the boilers. This elevator and screw are driven by a 15-hp. induction motor, the conveyor passing from the pulverizer building to the power house through a steel bridge covered with corrugated sides and roof. This is the only connection between the pulverizing plant and the power house.

The capacity of the pulverized plant is 180 tons in 24 hours and the requirements of the power house are at present about 96 tons in 24 hours. Arrangements are being made for the trial of pulverized coal in locomotive service, one engine now being in process of equipment, and an outside storage bin will be added to the plant to supply fuel directly to the locomotive.

The boilers are arranged in batteries of two each and, as equipped for burning gas and oil, the combustion takes

place in the furnace directly under the heating surface of the boiler. For pulverized fuel, however, a Dutch oven furnace has been built on the front of the boiler setting, it having been found that the best results are obtained in this manner. The equipment for burning the fuel is simple. Each pair of boilers is provided with a blower, driven by a 10-hp. constant speed direct current motor, the blast pipes from this blower entering the rear end of an induction tube which extends through the wall of each furnace. Each blast pipe is fitted with a gate for controlling the air jet to the combustion tube. The fuel from the bin passes through a four-inch screw feeder, which accurately determines the rate at which the coal is delivered to the furnace, each feeder being driven by a 2-hp. variable speed motor. The fuel from the feeders is led by gravity through a pipe entering the top of the induction tube near the front of the furnace. The action of the high velocity jet from the blast pipe induces a large volume of air at lower velocity through the induction tube; the fuel is caught by this current, with which it is thoroughly mixed, and enters the furnace at a low velocity, burning with a lazy flame which practically fills the combustion chamber.

The fuel bins in front of the boilers have a capacity equivalent to 16 hours' service at boiler rating. The bins and supports are of steel and the bins are closed with steel covers which are dust-tight. Each bin is hoppered and is equipped with a hand operated agitator, the purpose of which is to prevent the bridging over of fuel in the hopper.

Considerable experimental work has been done in order to secure the best furnace arrangement and to provide an effective control of combustion to meet the requirements of varying loads on the boilers. As installed for the use of gas, the boilers were provided with three-pass horizontal baffles. In the pulverized fuel fired boilers these baffles are being replaced by a vertical three-pass arrangement from which excellent results have been obtained, as the following list of temperatures indicates. These temperatures were taken starting at the bottom of the first pass and proceeding in the direction of the flow of the gases over the heating surfaces of the boiler.

Location—	Temperature, deg. F.
Bottom of first pass	1,650
Top of first pass	1,260
Top of second pass	1,180
Bottom of second pass	960
Bottom of third pass	800
Top of third pass	705
Stack temperature (average)	508

These temperatures were taken under operating conditions with a draught averaging .26 inch of water.

Various tests have been made with the different fuels mentioned and all of them were burned with entire success, giving an effective distribution of the heat throughout the heating surface of the boiler with low stack temperatures. No deposit of ash settled anywhere in the boiler but what was readily dislodged with an ordinary air blast.

With Texas lignite and an output of 110 per cent rating, an equivalent evaporation of 7.26 lb. of water was obtained per lb. of coal fired, an equivalent evaporation of 8.81 lb. being obtained per lb. of combustible. The coal as fired had a heating value of 11,250 B. t. u. and contained 7 per cent moisture, the dryer not being designed to handle this class of fuel regularly. The efficiency of the boiler was 67.3 per cent, the losses being as follows: .7 per cent due to evaporation of moisture in the coal; 4.8 per cent due to steam from hydrogen combustion; 11.8 per cent carried away by dry flue gasses, and 15.4 per cent due to radiation and unaccounted for.

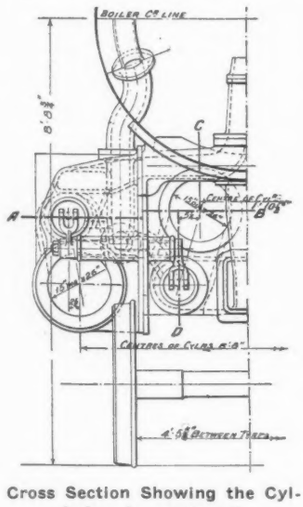
With the boiler operating at about 92 per cent of rated capacity an equivalent evaporation of 8.38 lb. of water per lb. of coal fired was obtained with Mineral slack (Cherokee Co., Kansas), the fuel as fired containing one per cent of moisture and having a heating value of 11,580 B. t. u. The equivalent evaporation per lb. of combustible was 10.9 lb. In this case the boiler showed an efficiency of 71.5 per cent, the losses being: .3 per cent due to evaporation of moisture in the coal, 3.8 per cent due to steam from hydrogen combustion; 10.8 per cent in dry flue gasses, and 13.6 per cent radiation and unaccounted for. In neither case was there any CO loss.

Including the cost of pulverizing, which is about 35 cents per ton, the cost of Mineral coal delivered to the bins was $1.795. The fuel of evaporating 1,000 lb. of water as determined by this test was 11.6 cents. Using natural gas, the heating value of which is about 940 B. t. u. per cu. ft., the cost of evaporating 1,000 lb. of water is 16 cents, with gas at 12.5 cents per 1,000 cu. ft.

The normal coal feed is arranged to develop about the rated capacity of the boiler. At maximum feed, however, the boilers may be forced to 142 per cent of rated capacity. No difficulty has been experienced from abnormal furnace temperatures, which would tend to destroy the furnace walls. Even under forced conditions the furnace temperature does not exceed 2,350 deg. F., and under normal conditions it is about 2,100 deg. F.

FOUR-CYLINDER ATLANTIC TYPE LOCOMOTIVE, GREAT NORTHERN OF ENGLAND

The locomotive illustrated was converted under the direction of H. N. Gresley, locomotive engineer of the Great Northern Railway of England, from a two-cylinder to a four-cylinder simple, the boiler being equipped with the Robinson superheater. The engine differs from other 4-4-2 type locomotives inasmuch as all four cylinders drive the rear coupled wheels. The arrangement of the cylinders and driving gear is shown in one of the drawings.



Cross Section Showing the Cylinder Arrangement.

The outside cylinders are inclined at 1 in 91½, or very nearly horizontal, but the inside ones are necessarily more steeply inclined in order that the connecting rod may clear the axle of the leading driving wheels. The angle of inclination is 1 in 8¾. For the same purpose, as is seen in the drawings, the Laird type of crosshead is used, thus dispensing with the lower guide bar, for which it would be difficult to find room above the axle in a locomotive of this wheel arrangement.

The outside connecting rods have a length of 10 ft. and the inside ones 7 ft. 7 in., the inside cylinders being located to the rear of the outside ones. Walschaert valve gear is applied directly to the piston valves of the outside cylinders, which valves work above the cylinders. Motion is conveyed to the piston valves of the inside cylinders by means of rocking levers and a transverse shaft with connecting mechanism, the motion being transmitted from the higher level of the outside valve spindles to the lower one of the inside valves, as is shown in the drawing, the valves of the inside and outside cylinders working in opposite directions. The crank axle is constructed on Ivatt's patent built-up balanced principle.

As originally constructed, the engine had two outside cylin-

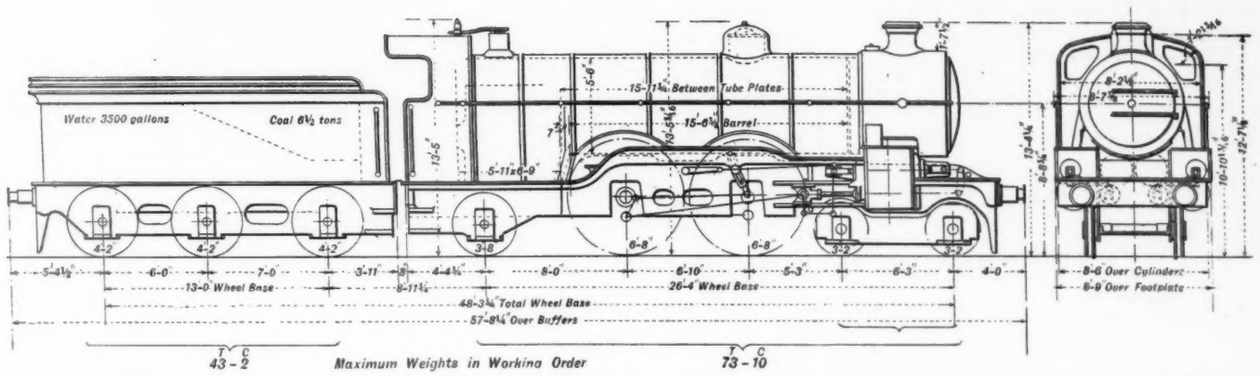
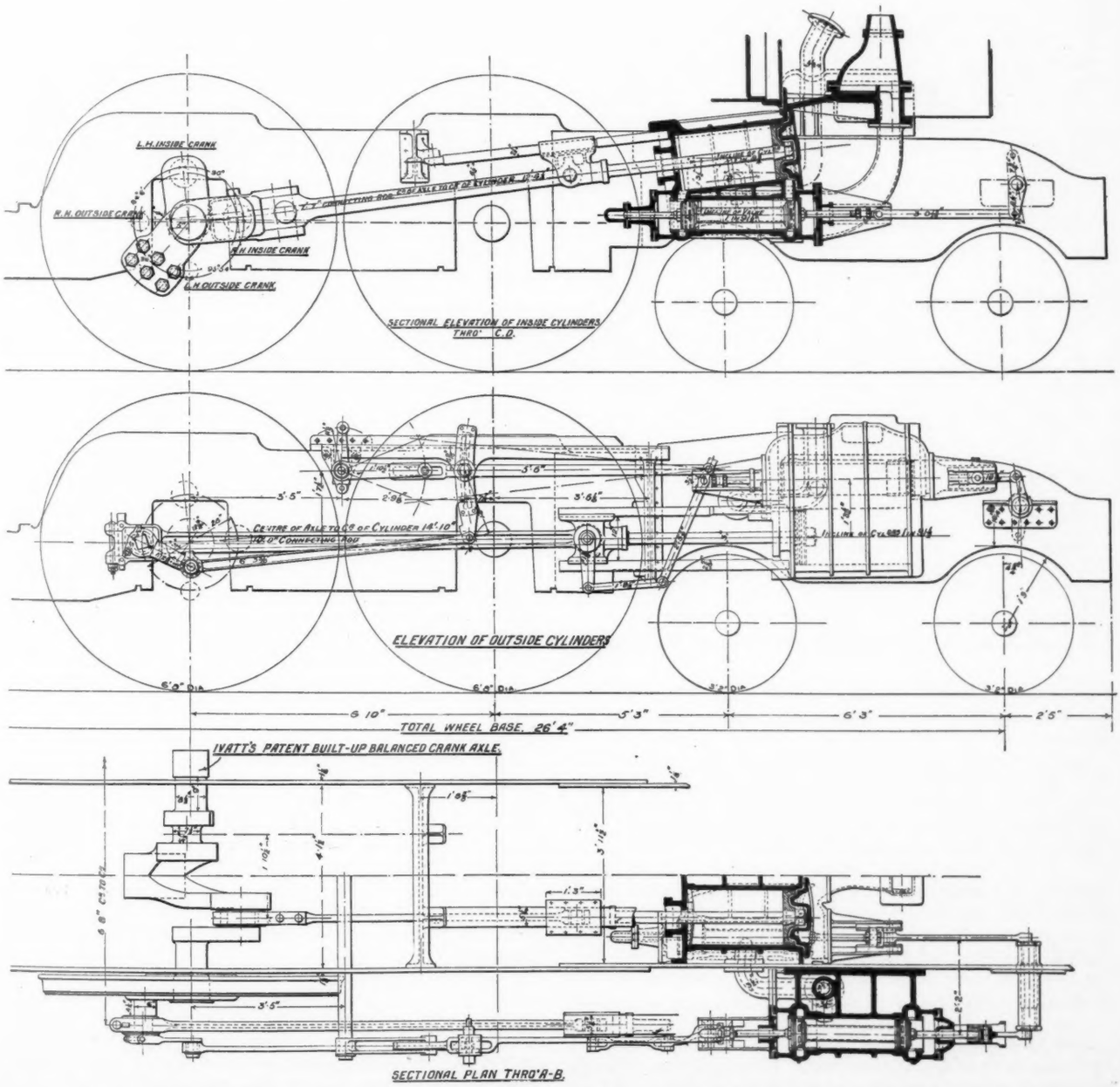


Diagram Showing the Principal Dimensions and Weights of the Great Northern Locomotive; The Weights Are Given in Tons of 2,240 lb., and Hundredweights.



Arrangement of the Cylinders and Rods of the Great Northern Atlantic Type Locomotive

ders, 18¾ in. by 24 in. The following are the leading particulars of the engine as now running:

Cylinders (four), diameter and stroke	15 in. x 26 in.
Driving wheels, diameter	6 ft. 8 in.
Heating Surface	
144 tubes 2¼ in. outside diameter = 1,355½ sq. ft.	
24 tubes 5¼ in. outside diameter = 526½ sq. ft.	1,882 sq. ft.
Firebox	138 sq. ft.
Total	2,020 sq. ft.
Superheater surface	427 sq. ft.
Grate area	31 sq. ft.
Working pressure per sq. in.	170 lb.
Weight in working order	164,500 lb.
Weight of engine and tender in working order	261,000 lb.

CHART FOR DETERMINING THE EXPANSION OF METALS

BY W. F. SCHAPHORST

The accompanying chart was devised to facilitate the calculation of expansion in various kinds of metals, ranging from mild steel to bronze. It covers any length of steam pipe or bridge, etc., from 20 ft. to 10,000 ft. On the scale of coefficients are indicated the values of the various materials so that the chart may be used direct without the necessity of first looking up this information.

The broken lines on the diagram indicate the method of using it and refer to the following example: How much will 850 ft. of wrought iron steam pipe expand where the

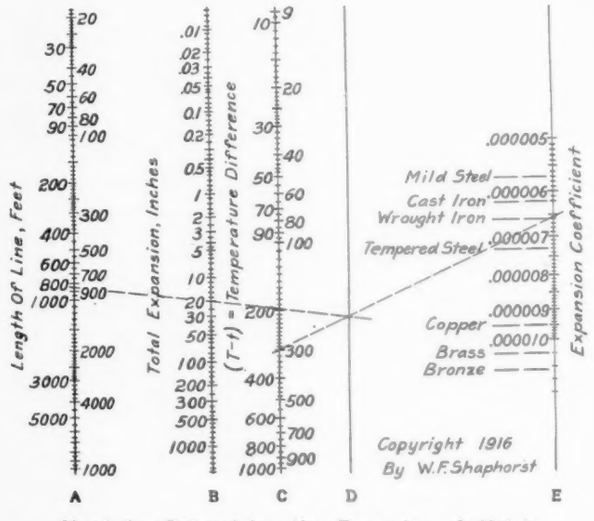


Chart for Determining the Expansion of Metals

temperature variation is 300 deg. F.? In solving the problem first connect the 300 mark on the scale of temperature difference (column *C*) with the coefficient of expansion of wrought iron on column *E*. With the point where the line thus drawn intersects column *B*, connect the point on column *A* which indicates the length of line, in this case 850 ft. The total expansion of the line in inches may be read directly from scale *B* at the intersection of this line.

It should be noted that column *B* shows the maximum variation of temperature, and not the maximum temperature, to which the material may be subjected. If the temperature of the steam pipe in the above example will never be below 40 deg. F. when cold and the maximum temperature is 340 deg., the difference of 300 deg. is the amount to be used in finding the expansion.

Applying Rubber Gaskets.—In placing rubber packing for joints it should be coated with either graphite or chalk to prevent adhering to the metal when the joint is to be broken.—*Power.*

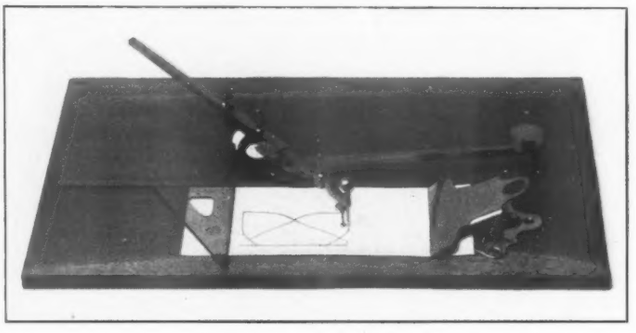
CLIPBOARD FOR ANALYZING INDICATOR CARDS

BY H. K. FOX

Motive Power Inspector, Western Maryland, Hagerstown, Md.

Within the past eight months we have taken about 1,400 indicator cards and the task of integrating them is no small one. The method heretofore followed was to pin a card on a drawing board with two thumb tacks, the surface for the planimeter wheel to roll over usually being a piece of smooth paper. For the integration of the diagram areas of a card this method gives a fair degree of satisfaction, but the real difficulty came when drawing parallel vertical lines at fractional parts of the stroke. When doing this with a pair of triangles several adjustments were frequently necessary to finish one card and a further annoyance was found in the tack heads, over which one of the triangles frequently had to be placed.

To overcome these obstacles to a quick solution, a clip-



Clipboard Used in Analyzing Indicator Cards

board was designed as shown in the illustration. On this board the cards are very quickly applied or removed, and this can be done as many times as desired without the least injury to the card. The clip firmly holds the card in position and a small straight edge is glued on the board to serve as a guide for the triangle. The board itself is about ⅜ in. thick, 9 in. wide, and 13 in. long. The straight edge is 0.06 in. thick and 0.25 in. wide, and is set about 3½ in. from the edge of the board, the set screws on the under side of the planimeter clearing it nicely. The clip is 3 in. wide, being made from an ordinary 6 in. clip by cutting off the proper amount from each wing. The board is of hardwood and the surface over which the roller wheel runs has been specially prepared to provide an extremely smooth, glass-like finish.

As to the saving in time required for working up cards, about five cards are now being analyzed in the same time formerly required for three.

Hardening in Electric Furnaces.—The latest electric furnaces cost about the same to operate as gas furnaces when the current is 3½ cents per kilowatt and the gas is 80 cents per thousand cubic feet, the gas having about 600 B. t. u. per cubic foot. One concern having electric furnaces using current at 1¾ cents per kilowatt gets its work hardened at a cost of about one-fourth cent a pound. But even if the cost were higher than with gas there is the great advantage of perfect control. An autographic record of the rise in temperature clearly indicates the critical point in the curve, and when the temperature has risen a few degrees above as shown by the recorder the charge is removed. Thus the hardener has an infallible guide, provided the pyrometers are checked daily and each heat is recorded. Inspection is checked against these records and each lot of steel is tested before fixing the temperature for quenching. By such exact methods is uniformity in hardness insured.—*Machinery.*

LOCOMOTIVE BOILER EFFICIENCY

Heating Surfaces Not Forced to Capacity; Grates and Combustion Chambers Are Forced Beyond It

BY J. T. ANTHONY*

II

HEAT REJECTED BY THE BOILER

THE heat rejected by the boiler heating surfaces amounts to a relatively small part of the total heat contained in the coal, varying from about 3 per cent to 7½ per cent for the boilers under consideration, as the rate of firing increases from 30 to 180 lb. While this loss is small, it is not entirely unavoidable, and can be reduced by slightly changing the arrangement of the heating surfaces.

The firebox heating surfaces receive heat by radiation from the fuel bed, luminous flames and incandescent brick work contained in the furnace. The amount of heat received by radiation depends primarily upon the extent of these radiating surfaces and upon their temperature. The transfer of heat to the firebox heating surfaces by convection takes place to a very limited extent.

The area of the firebox heating surfaces is of secondary importance to the grate area and firebox volume. The heat-absorbing capacity of water is so high and the conductivity of the firebox sheets is so great that it is impossible to get firebox temperatures high enough to force the firebox heating surfaces to full capacity, even with present firebox design.

Under maximum conditions of power output, it is possible that an equivalent evaporation of more than 60 lb. of water per square foot of firebox heating surface per hour is obtainable; but in order to get this evaporation it is necessary to have a drop of approximately 84 deg. in temperature between the fire side and the water side of the firebox sheets. With a steam temperature of 388 deg. this means (presupposing clean sheets) that the temperature of the plate on the fire side would be 472 deg. F.

If it were possible to obtain an equivalent evaporation of 100 lb. of water per square foot of firebox heating surface per hour, the temperature drop between the water side and the fire side of the sheets would be about 140 deg., or, the temperature of the fire side would be 528 deg.

Increasing the firebox heating surface adds slightly to its efficiency. By increasing the area of the surfaces receiving a fixed amount of radiant heat, we reduce the amount of heat to be absorbed by each square foot of heating surface, and therefore reduce the temperature difference between the fire and water sides of the sheets.

The amount of heat radiated depends primarily upon the area and temperature of the radiating surfaces, but is influenced to some extent by the temperature of the heating surfaces. A reduction in the temperature of the heating surfaces will increase the total amount of radiant heat absorbed and will increase the firebox evaporation, but not in proportion to the increase in heating surface.

The addition of a combustion chamber will increase the firebox evaporation to a small extent, by increasing the heating surface as explained if there is no increase in area or temperature of the radiating surfaces. However, the chief advantage of a combustion chamber lies in the fact that by promoting the burning of the volatile matter and coal-dust, it increases the mass of luminous flame which radiates heat; and, by increasing the extent of radiating surfaces, increases the firebox evaporation.

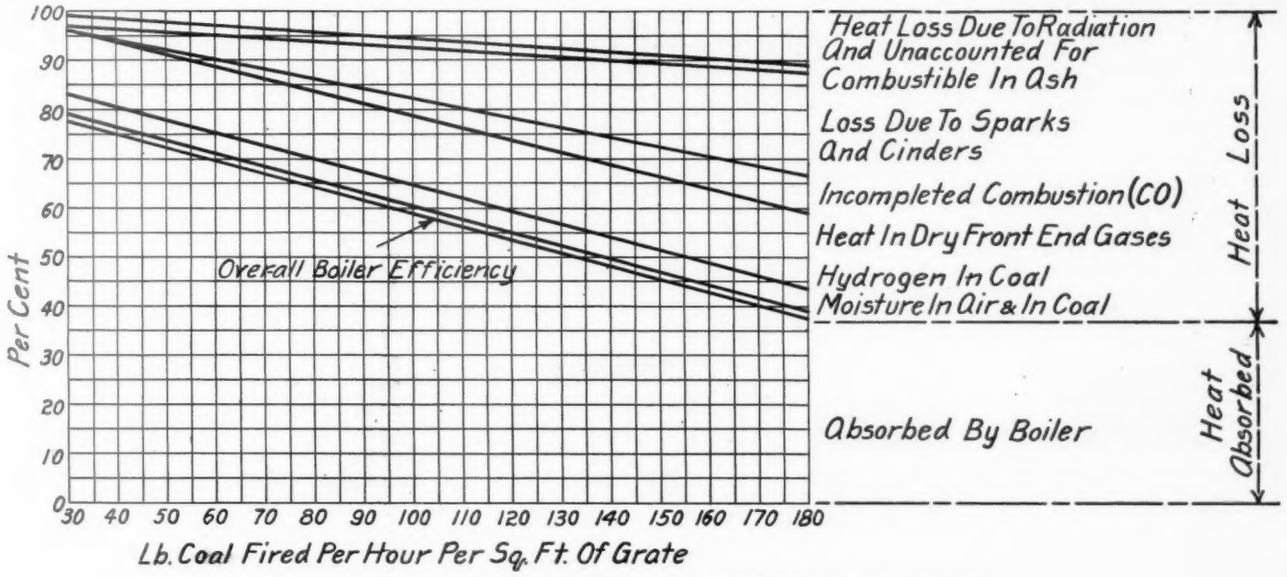


Fig. 1.—Heat Loss and Boiler Efficiency as Affected by Rate of Combustion

All of the heat generated in the firebox is either radiated to and absorbed by the firebox heating surfaces, or is carried out of the firebox by the gaseous products of combustion. It is obvious that any increase of heat absorption by the firebox will result in a lowering of temperature of the gases leaving the firebox and consequently will result in a decrease in the amount of heat to be absorbed by the tubes.

The efficiency of the tube heating surfaces increases slightly as the rate of heat transfer and evaporation decreases. Lowering the temperature of the gases entering the tubes by increasing the heat absorption of the firebox will,

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therefore, reduce the amount of heat to be taken up by the tubes and result in an increase in tube efficiency. It follows that under these conditions front end temperatures would be reduced and the boiler efficiency increased.

The small portion of tube heating surfaces adjacent to the firebox, which can be "seen" by the radiating surfaces, absorb some heat by radiation; but most of the heat taken up by the tube heating surfaces is by convection. That is, the heat is transferred from the hot gases to the boiler heating surfaces by the gases coming in actual contact with these surfaces and giving up their heat, which is transferred through the metal into the water by conduction. Convection implies intimate contact of the hot gases with the heating surfaces; and, in order to transfer the greatest possible amount of heat by convection, it is necessary to bring every particle of gas into actual contact with the surface of the tubes. Transparent gases do not radiate heat; neither does heat pass from one part of the gas to another by conduction. It travels only by convection—by the actual movement of the particles of gas from one part of the gas stream to another.

It has been stated that the firebox heating surfaces receive practically no heat by convection. It is now apparent why. The volume of gases passing out of the firebox is so great, and the cross sectional area of the firebox is so large compared with the circumscribing firebox heating surface, that it is evident that only a very small proportion of the gases could come into actual contact with the heating surfaces on their way from the fuel bed to the tubes.

There are three factors that influence the transfer of heat by convection: first, temperature; second, density; third, velocity. At one time it was thought that temperature was the only factor that needed consideration; but the possible effect of the other two factors was suggested a number of years ago (1874) by an English scientist, Professor Reynolds. Since then, his ideas on the subject have occasioned much study, discussion and experimentation, although scientists and engineers have not been able to agree on the exact effect of these several factors on heat transmission. It is necessary to discuss them briefly here.

Since the convection of heat can take place only when the particles or molecules of gas have actual contact with the tube heating surfaces, it is apparent that the amount of heat transferred will be influenced by the number of contacts, or blows of the molecules against the heating surfaces. Increasing the density of the gas increases the number of molecules per unit of volume, and increases the number of blows or contacts of the gas against the metal. Increasing the temperature of the gases decreases the density or weight per unit of volume; therefore the benefits to be derived from an increase in temperature are partly neutralized by the decrease in density of the gases.

The velocity factor is one of great importance. The molecules of gas, on striking against the soot-covered heating surfaces, give up their heat, lose their vibratory energy, and, perhaps becoming entangled in the layer of soot, begin to build up a cold and insulating layer of gas film, next to the tube surfaces. As gases do not radiate heat, this cold film offers a very effectual resistance to the passage of heat from the body of the gas flowing through the tube. In order to overcome this resistance, it is necessary to tear away this cold, non-conducting film, to give the hot molecules of the gas access to the heating surfaces. The scrubbing and scouring action necessary to break down this film can only be obtained by getting a high velocity of gas flow. At low velocities, the tendency of a gas is to travel in straight, parallel strata (or "stream-lines") of flow, unbroken by eddying currents. As the velocity of the gases increases, this stream-line flow shows a tendency to break up. At a certain point, called the "critical" velocity, violent eddying of the gases takes place and the smooth stream-line flow disappears. It is not difficult to imagine how, under the influence of this stream-line flow, a cold, insulating layer of gas could be built up next to the tube heating surfaces; nor is it difficult

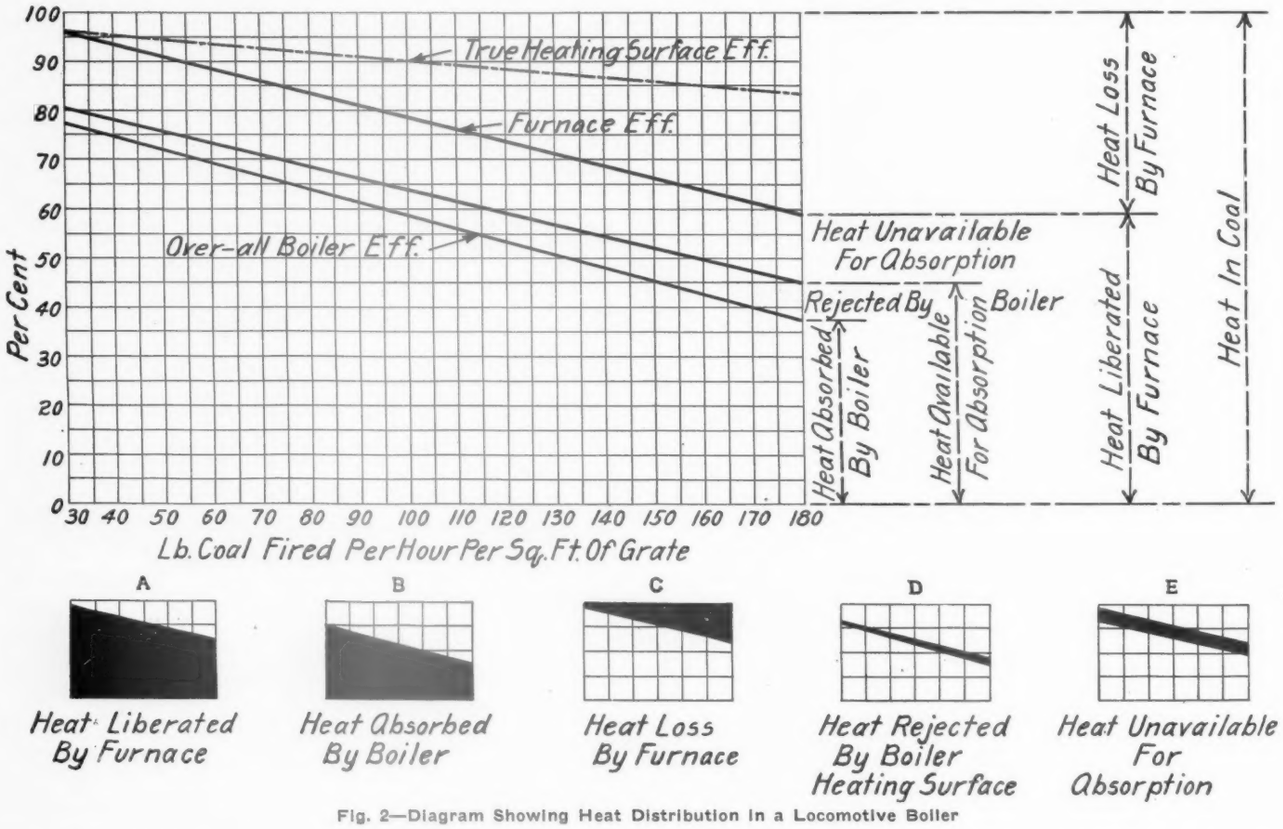


Fig. 2—Diagram Showing Heat Distribution in a Locomotive Boiler

to imagine how the high velocity and violent eddying of the gas currents would tend to tear down this cold layer of gas and give the hot gas access to the heating surfaces.

This critical velocity is dependent upon the temperature of the gases and the diameter of the tubes. As the temperature of the gases increases, the critical velocity increases; and as the diameter of the tube increases, the critical velocity seemingly decreases. From this last statement it might appear that an increase in the diameter of the tubes would be of advantage, but such is not the case.

As stated before, the amount of heat given off by the gases (other things being equal) depends upon the number of blows that the molecules of gas strike against the heating surfaces. As the gases flow through the tubes the molecules are vibrating rapidly from side to side. This molecular vibration increases as the temperature increases, but the number of contacts made by any one molecule against the tube surface will depend not only upon the velocity of its movement from side to side, but also upon the average distance it has to travel from the body of the gas to the heating surface. It is obvious that by increasing the diameter of the tubes, we increase the average distance that each small particle of gas has to travel, in order to come in contact with

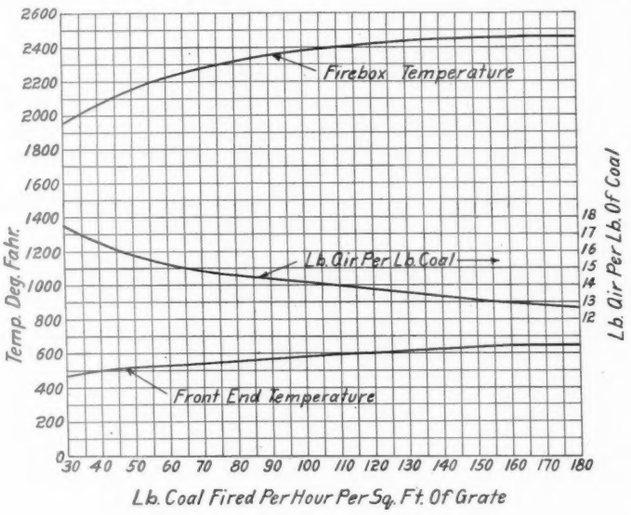

Temp. Deg. Fahr.
Lb. Air Per Lb. Of Coal
Firebox Temperature
Lb. Air Per Lb. Coal
Front End Temperature
Lb. Coal Fired Per Hour Per Sq. Ft. Of Grate

Fig. 3—Air Supply and Temperatures

the tubes; and thereby decrease the number of contacts and the amount of heat transferred.

Tube efficiency increases as the diameter decreases and as the length increases; but not in direct proportion to the increase in length. With each successive increase in length, the heat absorption becomes proportionately less, and there is a stage easily reached at which any increase in tube length gives an imperceptibly small increase in efficiency. Tests made abroad and tests made by the Pennsylvania Railroad at Altoona indicate that a tube length of from 100 to 110 times the internal diameter is best adapted to combine free steaming, high capacity and efficiency. It is probable that efficiency of tube heating surfaces can be best increased by reducing the diameter of the tubes rather than by increasing their length. The problem is to get every molecule of the hot gases into intimate contact with the tube heating surfaces, and the smaller gas passages offer greater opportunity for each particle of gas to come into contact with the heating surfaces and give up its heat.

The tubes now used as standard by the American railroads are 2 in. and 2¼ in. diameter. There would no doubt be objections raised to a reduction in diameter, partly on the score of increased tube blowing, due to the liability of the smaller tube to become filled and plugged with cinders and slag. Such would be the case with the present design of firebox, but the smaller and shorter tubes should be used in conjunction with long combustion chambers. The increased firebox efficiency to be had with a firebox of ample size, with efficient baffling and gas mixing devices and a long combustion chamber, would result in such a great reduction of the trouble due to sparks, cinders, slag and honeycomb, that smaller tubes could be run with probably less trouble than is had with the present sizes.

If the present size of boiler shell were adhered to, a reduction in the diameter and length of tubes would result in a reduction of the total heating surfaces. Such a reduction in heating surfaces does not necessarily mean a reduction in boiler efficiency or capacity. The capacity and efficiency of our modern locomotive are chiefly limited by the ability of the firebox to burn the coal and liberate the heat contained, not by the ability of the heating surfaces to absorb the heat.

Tests indicate that there is a rapid drop in the efficiency of the tube heating surface, as the velocity of the gases increases from zero up to the point of critical velocity. Once this point is reached, however, the efficiency line becomes almost horizontal, dropping but little with the continued increase in velocity of the gases and increase in evaporation. While the tests mentioned are not conclusive, they seem to indicate that the tube heating surfaces can be forced to a much higher capacity than is now common practice, without decreasing the efficiency to any great extent. The curves in Fig. 2 seem to bear this out. There is a slight drop in the heating surface efficiency as the rate of evaporation increases; for in order to evaporate more water per unit of area, it is necessary to increase the rate of heat transfer to the heating surfaces. This calls for an increase in temperature drop from the fire side to the water side, or an increase in temperature of the fire side of the tube. Such an increase in temperature of the heating surface necessarily increases the temperature of the gases escaping and results in a slight decrease in heating surface efficiency.

UNAVAILABLE HEAT

By the term "unavailable heat" is meant that portion of the heat contained in the gaseous products of combustion that is not available for absorption by the tube heating surfaces, even though such surfaces were 100 per cent efficient. These heating surfaces cannot reduce the temperature of the gases below the temperature of the water in the boiler; therefore, the heat required to raise the products of combustion from the atmospheric temperature to the temperature of the water or steam in the boiler is unavailable for absorption by the boiler heating surfaces. As shown in the chart, Fig. 2, this heat loss amounts to about 15 per cent of the total heat contained in the coal, and remains practically constant throughout the range of tests.

The percentage of this unavailable heat depends:

First—Upon the temperature of the water or steam, which in turn depends upon the pressure;

Second—Upon the air supply per pound of coal;

Third—Upon the amount of moisture contained in the air, and the amount of available hydrogen in the coal, which on burning forms water;

Fourth—Upon the temperature of the front end gases;

Fifth—Upon the temperature of the superheated steam flowing through the superheater units.

Any increase in boiler pressure means an increase in steam temperature, and this increases the amount of heat in the gases unavailable for absorption. From the standpoint of boiler efficiency, lower boiler pressures are desirable; but the demand for capacity is so great that a reduction of boiler pressure is almost out of the question.

If, at any given rate of combustion, we increase the air supply, there is a corresponding increase in the amount of heat contained in the gases that is unavailable for absorption. While the total amount of heat in the gases might be

the same, the temperature of the gases is reduced and the ratio of steam temperature to front end temperature is increased, thereby increasing the percentage of unavailable heat. If, at any given rate of combustion and fixed air supply, the front end temperature is increased, the amount of heat contained in the escaping gases is increased, but the ratio giving the percentage of unavailable heat in the front end gases will be decreased. Fig. 3 indicates that as the rate of combustion increases front end temperatures increase and the air supply per pound of coal decreases. The latter partly offsets the increased loss caused by the former, the percentage of unavailable heat remaining almost constant.

Most of the heat contained in steam escaping at the front end (formed by the evaporation of moisture in the air and burning hydrogen in the coal) is unavailable for absorption, because the larger part of the heat so contained is absorbed in evaporating the water into steam. This heat of evaporation is not available and cannot be regained unless the temperature of the front end gases can be reduced sufficiently to cause the steam to condense. At atmospheric pressure the steam would not condense until reduced below 212 deg. F. Since it is impossible to reduce the temperature of the gases below the temperature of the steam or water in the boiler, it follows that in a locomotive boiler equipped with a fire tube superheater it is impossible to reduce the temperature of that portion of the gases coming in contact with the superheater units below the temperature of the steam in those units. With a boiler pressure of 200 lb., the temperature of saturated steam would be 388 deg. The temperature of the superheated steam entering the header might possibly be 650 deg., and it would be impossible to reduce the gases in contact with a part of the units below this temperature, therefore, the amount of heat unavailable for absorption would be increased. This would increase the front end temperatures and reduce overall boiler efficiency.

The advantages of high degree superheat outweigh the advantages of slight increase in boiler efficiency to such an extent that a reduction in heat losses due to this source seems hardly worth considering.

It is evident from the above that the utilization of this "unavailable" heat is not within the province of the bioler proper, and a reduction in the amount of heat so lost can only be brought about by the use of auxiliary apparatus. Front end superheaters and feed-water heaters have been tried out with very little success. The front end superheater has been discarded, because of the very low degree of superheat obtainable and on account of maintenance troubles. The front end feed-water heaters so far tried out have not been highly satisfactory, but the fact that virtually one-seventh of all the heat contained in the coal is unavailable for absorption by the boiler surface and can only be made use of by the adoption of auxiliary apparatus offers a large field for inventors and designers. This front end heat loss is entirely independent of the loss caused by the discharge of exhaust steam which is used for draft-producing purposes. The possibility of using part of the heat from this exhaust steam for heating feed-water has been recognized and a feed-water heater of the "film" type is now being developed for this purpose.

SCALE AND SOOT

Nothing has been said about the possible effect of scale and soot upon heat transmission and boiler efficiency. It has been very difficult in the past to secure accurate data showing the effect of scale or of soot upon the transmission of heat. There is no doubt, however, that any accumulation of foreign substances upon the heating surfaces does interfere with heat transmission and does increase the heat losses. All the time and attention given to boiler washing and tube cleaning will be more than repaid by the fuel saving, to say nothing of the reduction in boiler repairs and engine failures.

CIRCULATION

The circulation of water around the heating surfaces is of prime importance. Dead water spaces and steam pockets must be avoided, from a standpoint of safety as well as efficiency. The circulation should be at least sufficient to keep the steam bubbles swept away from the heating surfaces, and higher velocities are desirable; but from an efficiency point of view, velocity of circulation is not of first importance. The heat-absorbing capacity of water is so high that comparatively little difficulty is experienced in transferring heat from the wet side of the heating surfaces to the water. The boiler plates offer comparatively little resistance to the flow of heat from the dry surface (or fire side) through to the wet surface (or water side). The main difficulty lies in getting the heat out of the coal and into the heating surfaces.

SUMMARY

The hauling capacity of a locomotive is dependent upon the ability of the boiler to furnish steam.

The capacity of the boiler is limited by the ability of the firebox to liberate the heat contained in the coal fired.

The capacity of the firebox and grate is reached much sooner than the capacity of the heating surfaces.

The low boiler efficiency at high capacity is due to the inability of the firebox to properly burn the coal, not to the inability of the heating surfaces to take up the heat.

The largest field for improvement lies in the firebox. Large grate areas and moderate rates of combustion are essential for capacity and efficiency.

Coal cannot be burned economically at high rates of combustion. The evaporation does not keep pace with the amount of coal fired. Increasing the rate of combustion from 30 to 180 lb. means that we are burning six times as much coal but evaporate only three times as much water.

Ample air supply is absolutely essential. Ashpan air openings should be large enough to prevent any pressure drop in the ashpan. Air openings through grates should be as large as physical characteristics of the coal permit. It is not necessary to throttle the air at the ashpan or grate, the fuel bed will take care of this.

A large percentage of bituminous coal burns as a gas, and provisions must be made for properly burning this gas. Refractory baffles, mixing devices and long combustion chambers are essential.

Firebox evaporation depends upon the area and temperature of the radiating surfaces—that is, fuel bed, brick work and flames.

Firebox heating surface is incidental to the size of grate and volume of combustion chamber space.

The efficiency and capacity of the boiler are not governed by tube length nor the extent of tube heating surfaces.

Increasing tube length beyond 100 times the internal diameter gives but little increase in efficiency or capacity.

The efficiency of a tube increases as the diameter decreases. The heat can best be extracted from the gases by breaking them up into small streams.

The efficiency of a tube decreases slowly, after the gases reach the point of critical velocity. Their capacity can be greatly increased after this point is reached, with a very small decrease in efficiency.

The present heating surfaces of both firebox and tubes are not being forced to their capacity.

Grates and combustion chamber space are being forced beyond their capacity.

The efficiency of the firebox can be increased by providing larger grates, refractory baffles, gas mixing devices and longer combustion chambers.

If necessary to reduce the tube lengths below 100 times their present diameter, in order to accommodate the longer combustion chamber and larger grate, the diameters can be decreased proportionally and the efficiency maintained.

PRESENT DAY LOCOMOTIVE PROBLEMS*

A Few of the More Important Phases of Design and Operation Greatly in Need of Attention

BY GEORGE M. BASFORD†

WHEN this club began (1901) the biggest locomotive in the world was, I believe, a Consolidation running here in Pittsburgh. For a long time after that locomotives ran to size and weight. It was easy to make them bigger and heavier. But a far greater and more difficult as well as more important problem faces us today. It is the problem of forcing every pound of weight to justify itself in terms of power to serve mankind. Who has a bigger, nobler opportunity and duty than this?

When our club began, officials wouldn't listen, as they do now, to consideration of improved efficiency. Superheaters, brick arches, combustion chambers and feed water heaters are old. Their real application to our great problem came but six years ago, and they are only now beginning to be really used in this problem. Today officials are reaching out for new things and old things in new application. They eagerly seek capacity increasing factors. Why? Because they are facing the question of increased weights in equipment and in operation. They need more power per unit, to do the world's business and do it economically.

Therefore young men never had the opportunity or the duty that they have facing them today. Do they realize it?

Let us make a little list of big possibilities in locomotive development to show what lies before young railroad men right now. The items are mentioned at random, not in order of importance.

Boiler Design as a Whole.—Size is only one part of this problem instead of being the chief feature as it has been considered in the past. It is now a question of balancing all factors to make and to absorb the maximum amount of heat per unit of weight. The day of ratios between grate area, heating surface and cylinder volumes has given place to a day of providing steam to produce definite amounts of cylinder horse power within defined limits of weight. This is revolutionary and the corralling of many a fractious heat unit must be made possible.

Boiler Circulation.—Many a bright mind is engaged in improving the movement of the water in the boiler with the promise for the future. Very little positive information is available now upon this subject. Who will put us straight on the matter of boiler circulation?

Improved Grates.—Grate design is now being studied as it never has been before. Experimental developments in grates as to air openings and grate construction promise valuable improvements in the near future. Conditions requiring maximum power lead to the conclusion that air openings through the grates should be as large as the character of the coal used will permit. Thirty per cent is aimed at. Recognition is waiting for a thoroughbred grate expert. The largest Pacific type passenger locomotive has 47,500 lb. tractive effort and the same grate area that was used in the same service six years ago when the tractive effort was but 32,900 lb. This problem is a worthy one for that expert. What is he going to do about it?

Ash Pan Design.—This is a vital factor in the production of heat. To provide air sufficient for intense combustion is the object of experiments now being conducted which promise a simple solution of this problem. To provide air enough for a big firebox and put the air where it is wanted is no child's play. The speed of gases at a certain point in a big firebox, working hard, is 200 miles per hour. Who is the expert who will point the way to the ash pan design to supply air enough and how will he provide air openings in the ash pan sufficient to maintain atmospheric pressure in the ash pan at maximum rate of power development?

Combustion Engineering Applied to Firebox Design.—The purpose is to attain, with all fuels, the highest degree of heat intensity per unit of firebox volume. Here is where the energy is developed. This is the heat factory. It is worthy of a lifetime study. Important developments are nearly ready to be announced. Your field is nearly 70,000 fireboxes.

To burn the gases completely before they reach the flues and to accomplish this in the big firebox is another big problem. This involves grates, arches, air admission below and directly into the fire and mixing of the burning gases by division into small streams. It also involves the shape and size of the firebox and combustion chamber. All this is now being worked out on paper and in practice. Recent studies in firebox design recognizing the great importance of heat radiation and the relatively small importance of transfer of heat by convection have revealed the firebox problem in a new light. This will result in larger fireboxes, larger grates, larger combustion chambers and in new developments in the mixing of the burning gases by improvements in brick arches. Improvements already tried experimentally promise remarkable results. With all this to do, the field for combustion experts is very far from being over crowded. Before long 100,000 fireboxes will be in service to keep this country going. A little improvement applied to each of these will save a mountain of money.

It is known that a certain sacrifice of tube heating surface for the benefit of increased firebox volume in the form of a combustion chamber is justified but how far should this be carried? This should be investigated. Then there is the question of tube length.

Front End Draft Appliances.—Here is another field of promise. To produce the pump action necessary for draft with minimum back pressure load on the cylinders will bring great credit to the one who is successful in working it out. Why should front end construction that itself consumes 33 per cent of the draft produced be perpetuated?

Detail Design.—Developments in details to enable locomotives to run between shoppings with minimum running repairs present interesting possibilities. Shoes and wedges, journal boxes, hub liners, long driving boxes, improved throttles, lubrication, engine truck, trailing truck, tender truck design, also improved couplings of locomotives to tenders and radial motion for front and rear driving axles of long wheel base locomotives all bear on this question.

Tender Design.—Tenders may be said to have been somewhat overlooked in the speed of going to heavier and more powerful locomotives.

Labor Saving Devices.—Here is a definite line for development which is well started in power reverse gear, power operated firedoors and grate shakers and coal pushers, also the greatest of all these devices, the mechanical stoker. All these factors are needed because of the increased size of the locomotive. This renders it necessary to provide power auxiliaries to take the place of physical strength and endurance. Then locomotive operation becomes a matter of brain work rather than brute force.

Improved Valve Motion.—Great strides in this direction in ten years give encouragement to the hope that there is

*From a paper on Railway Clubs and Young Men, presented at a meeting of the Railway Club of Pittsburgh, Friday evening, September 22, 1916.

†President, Locomotive Feed Water Heater Company, New York.

more improvement to come. How crude the valve gear of the past would look on a big modern locomotive from the standpoint of convenience, let alone the question of economy in performance and the possibility of standardizing construction! Imagine yourself crawling under the wheels of a big modern locomotive to get at the eccentrics!

Superheating.—This improvement is by no means finished. Those who are living with this problem are in position to lead still further in their influence on cylinder performance and in the effective use of the heat from the firebox. Superheating engineers are ready to give higher superheat when railroads are prepared to use it by improvements in operation and maintenance. Great economies are available in higher superheat through increase in volume of the steam. These engineers are also ready to put to good use any increase of firebox temperature the combustion engineers can give them. Superheating, the greatest improvement the locomotive has ever seen, is not finished. It offers still greater possibilities when you are ready for them.

Feed Water Heating.—This is now a factor in locomotive engineering and operation. It promises to take a place next to superheating in improving economy and increasing capacity with the incidental advantage of prolonging boiler and firebox life and reducing cost of boiler maintenance. Successful feed water heating means increased boiler power. It will permit of modernizing existing boilers of outclassed locomotives to render them available again in many cases for service which has outgrown them. Feed water heaters may be applied to existing locomotives under a charge to capital account and for a number of years will defer charges to operating account for replacing those locomotives by new ones. Feed water heaters will increase evaporation per pound of coal and provide economy not available in any other way because the improvement is made from otherwise wasted heat. Locomotive boilers should be relieved of the duty of heating water. It should come to them hot, leaving only the evaporation to be effected in the boiler. Feed water heating is not new but successful locomotive feed water heating in this country has but just now been accomplished. A little later there will be more to be said on this subject. This development has been waiting for the successful heater.

Compounding.—This principle is coming to its own. No locomotive improvement fills its natural field so well as when it is properly fitted into the general scheme of locomotive design as the compound feature is fitted into the Mallet.

Water Purification.—This becomes more important every day. Before long people whose lives have been made miserable by water unfit to use in boilers of any kind will wonder why they ever used it in the most rigorous boiler service in the world. They will wonder why they ever paid the boiler repair bills of the past when the remedy is so easy and the returns so great. Let some of the young men tackle the problem of improving means and methods of water purification.

Brake Shoes.—Do you remember any illuminating paper on the subject of brake shoes within a year or two before any of the clubs? Here is an inspiring, live, subject—this and the clasp brake. It would be specially appropriate for this club to record brake and braking progress as a whole in a fitting manner and tell the railroad world what it is missing and what it ought to do.

Air Brakes.—So great have been the improvements in means of stopping trains that the authorities of a few years ago have now new subjects to study if they would keep abreast of progress. The electric control and the automatic adjustment of braking power to load in addition to other improvements are distinctly revolutionary in their effect on the capacity of railroads as well as on the safety of travel. The capacity of some very important railroads is specifically a question of brakes. Do the railroads know what they ought to do next in air brakes?

Powdered Fuel.—Herein lies a possibility of the use of heretofore impossible fuels with a $250,000,000 annual steam locomotive fuel bill to work on, also the possibility of increased steam making capacity and perfection of firebox operation that until recently were not hoped for. Increased hauling capacity and continuity of locomotive operation and eliminating of ash pit delay offer great promise for the future. Increased boiler capacity is a question of producing maximum calorific intensity per cubic foot of firebox volume. This is the raw material for the heating surface and superheater to work with. Speaking in general terms pulverized fuel will transform an 80 per cent boiler into a 100 per cent boiler. Consider what this would mean to say 30,000 locomotives in this country that are deficient in boiler capacity. Here again a capital charge will put from five to ten years of new life coupled with increased capacity into a lot of old power. It will put many an outclassed locomotive back on the main line. The chief reason for buying new locomotives is to get boilers that are big enough to haul maximum tonnage over ruling grades. Increased boiler capacity resulting from fuel efficiency is the question answered by pulverized fuel. It has already shown a boiler efficiency of 77 per cent with pulverized Kentucky unwashed screenings, as compared with 61.1 per cent with lump coal from the same mine hand fired in the same locomotive.

Alloy Steels.—If you could see confidential figures now in the desk of your speaker some of you would jump to the task of improving locomotive design with respect to lightening reciprocating and revolving parts of locomotives. This means making every pound of weight work for you. It includes possibilities in locomotives and tender designs as well as parts of running gear. It is difficult to understand how the possibilities of improved use of a pound of weight rendered possible by improved detail design of running gear could have been overlooked so long. Your speaker has recently given three years to this study and is in position to state that there is an insistent need of brain work followed by action in this field. There is not a minute to lose in taking up the light part and counterbalance questions and the reduction of dynamic augment by improved designs and alloy heat treated steels.

Signaling.—This has become a matter of speed control and increased capacity of track as well as a safety provision. Wonderful strides are being made in this field that are not widely known or well understood. Signaling is seldom mentioned before the various railroad clubs. It will have an important effect upon the operation of locomotives in the near future.

Do you want more things to do? Then get into locomotive operation. Work out plans for keeping expensive locomotives in service a larger portion of the day. An average figure representing present practice is 4 hr. 19 min. actual service out of a 24-hour day. Get into questions of organization, selecting, training and promotion of men. Who will wake up the railroads to the suicidal policy of neglect of the selection of recruits and of training these recruits in all departments? Take up the question of railroading as a business with real cooperation of all departments. Study suitability of locomotives to their working conditions. Who will show railroad managers how much money may be made in suitable roundhouses and in shops and shop equipment for maintaining big engines? No specific mention of the details of the car problems can be made on this occasion but the car offers opportunities that are little less important than those of the locomotive.

Best locomotive records, reflecting up to date developments show a water rate of 14.6 lb. per indicated horse power hour. What may be termed unimproved locomotives produce this unit on about 24 to 30 lb. Between these figures lie great possibilities. Between them lies your opportunity. The majority of locomotives are in or near the 24 lb. class.

Car Department

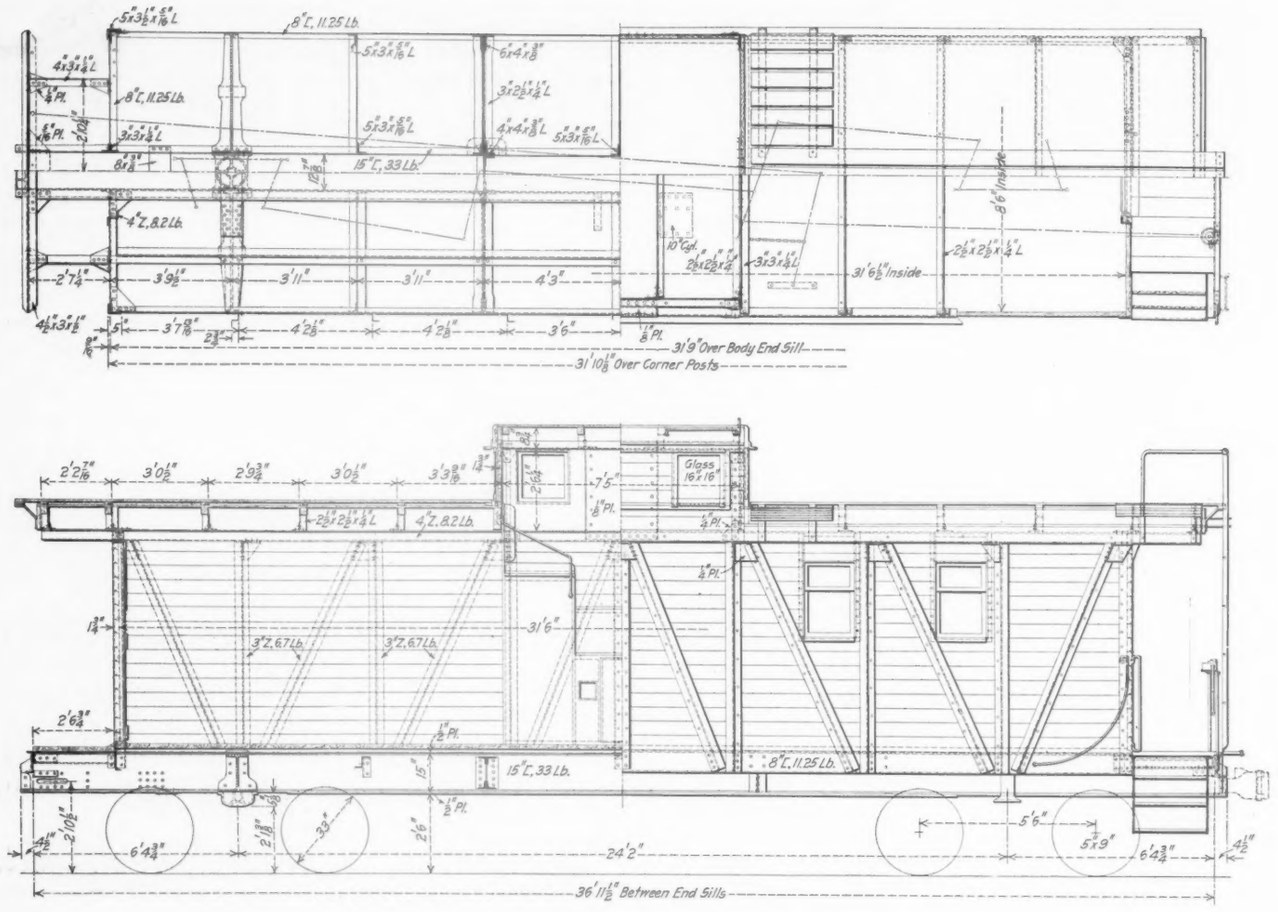
CABOOSE FOR THE N., C. & ST. L.

The Nashville, Chattanooga & St. Louis on its Chattanooga division passes over the Cumberland mountains. Pusher service is required to get the tonnage trains over this grade. With the installation of the Mikado locomotives on this division the tonnage of the trains has been materially increased and Mallet locomotives having 99,000 lb. tractive effort have been installed to push them over the mountain. This has made necessary the construction of 30 cabooses of sufficient strength to be used ahead of the Mallets. They were designed and built at the company's shops at Nashville, and have substantial steel underframes, steel frame superstructures and are of the single sheathed type. They weigh 41,000 lb. each and have the following dimensions:

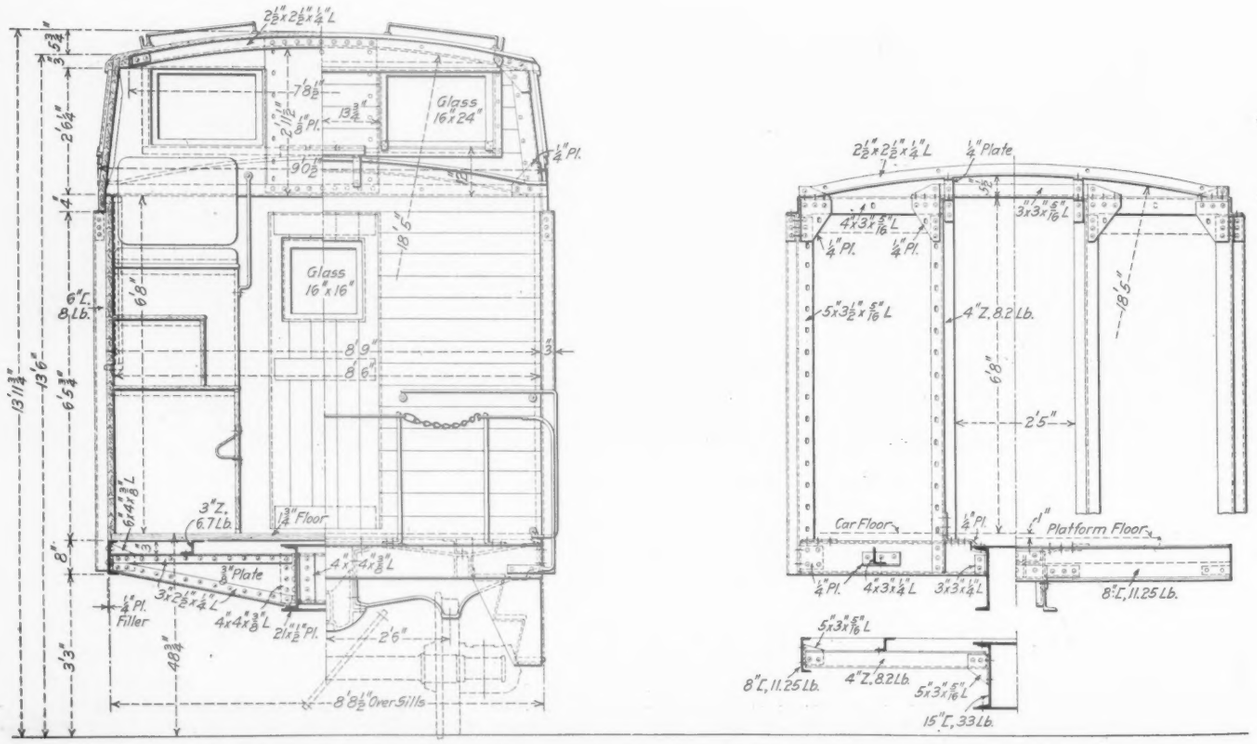
Length over striking castings	37 ft. 8½ in.
Length inside	31 ft. 6½ in.
Length between end sills	36 ft. 11½ in.
Width inside	8 ft. 6 in.
Height from floor to top of rail	4 ft. 6¾ in.
Height from rail to top of running board	11 ft. 8¾ in.
Center to center of trucks	24 ft. 2 in.
Truck wheel base	5 ft. 6 in.
Width of platform	2 ft. 6 in.

The underframe is made of structural shapes, the center sill consisting of two 15-in., 33-lb., steel channels extending the full length of the car and under the striking castings. They are spaced 12⅞ in. from back to back, the flanges being turned outward, and are covered for their full length by a top cover plate 21 in. wide by ½ in. thick, which extends over the body bolsters. The bottom cover plate is of the same material and extends between the bolsters. The center sills are connected at each crossbearer by a 12-in. channel spacer connected to each center sill by one 4-in. by 4-in. by ⅜-in. angle. The two crossbearers are made up of ⅜-in. web plates bound at the top and bottom on each side by 3-in. by 2½-in. by ¼-in. angles. They are connected to the center sill by two 4-in. by 4-in. by ⅜-in. angles and to the side sill by two 6-in. by 4-in. angles. The side sills are 8-in., 11.25-lb., channels extending the full length of the car between the end sills, being connected to them by the 5-in. by 3½-in. by 5/16-in. corner post angles. The end sills are made of the same material and extend the full width of the car. They are connected to the center sill by 5/16-in. gusset plates and the striking castings. The body bolsters consist of steel castings which extend between the center and side sills. They are the same as those used on the road's 80,000-lb. capacity box cars. A cover strap riveted to the top of the bolster passes over the center sills, securely tying together

Steel Frame Single Sheathed Caboose for the N. C. & St. L.



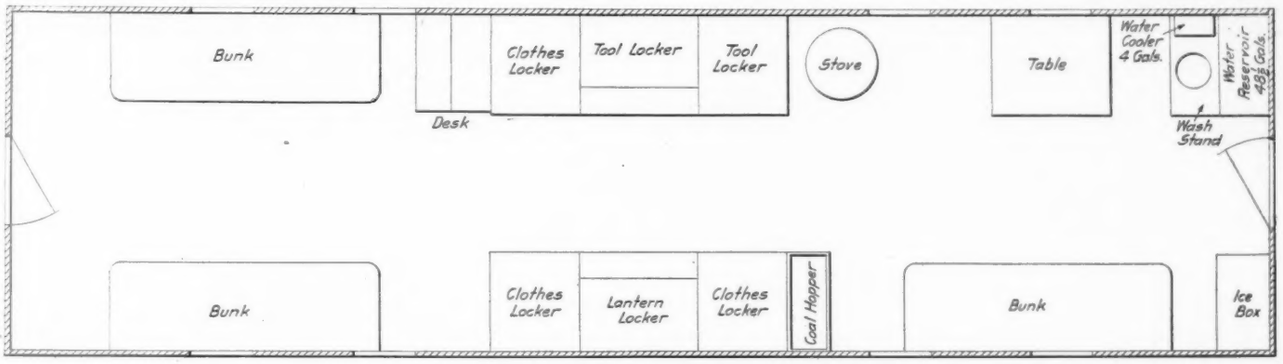
Plan and Elevation of the Caboose Cars



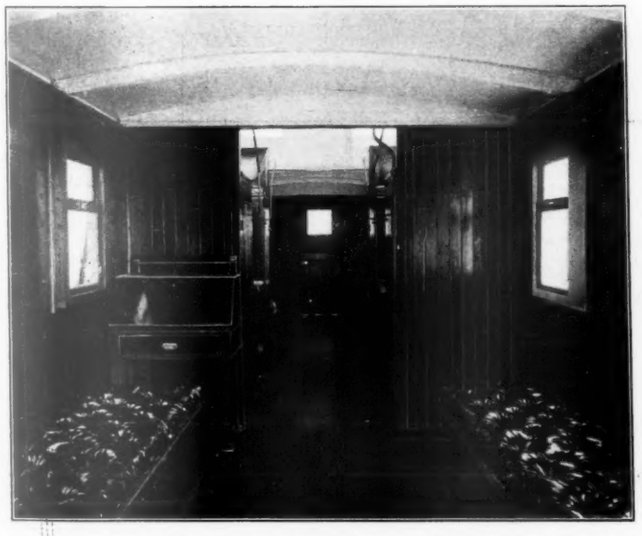
End Elevation and Sections of the N. C. & St. L. Caboose Cars

the body bolsters on each side of the sills. The connection between the center sills at the body bolster is made by a steel truck center casting. There are three floor beams per car which consist of 4-in., 8.2-lb., Z-bars fastened to the center and side sills by an angle bar. The floor stringers consist of two 3-in., 6.7-lb., Z-bars extending between the end posts and fastened to the end sill.

The framing of the car is similar to that used in the 80,000-lb. capacity box cars. The side posts and braces consist of 3-in., 6.7-lb., Z-bars which are riveted to the side sills and are connected to the side plates by ¼-in. steel gusset plates. The end posts consist of 4-in., 8.2-lb., Z-bars which are riveted to the end sills and are connected to the end plates by angle bars as shown in the drawing. The corner posts are 5-in. by 3½-in. by 5/16-in. steel angles. The side plates consist of 4-in., 8.2-lb., Z-bars and the end plates are 4-in. by 3-in. by 5/16-in. angles. Both the side plates and end plates are riveted directly to the corner post angles. The carlines are made of 2½-in. by 2½-in. by ¼-in. angles filled with 2½-in. by 2½-in. filler blocks to which is nailed the roofing. The lining is 1½-in. tongued and grooved yellow pine having a 5½-in. face on all except the top board, which is 8¾ in. The roof lining is 13/16-in. yellow pine. It is covered with Follansbee slow process tin. The flooring is ship-lapped yellow pine 1¾ in. thick with a 7¼-in. face. The flooring is secured to the steel stringers by ½-in. carriage bolts. The cupola framing is built up of steel plates and angles. The conductor's valve may be operated from the outside on both ends of the cupola and from either of the interior cupola seats.



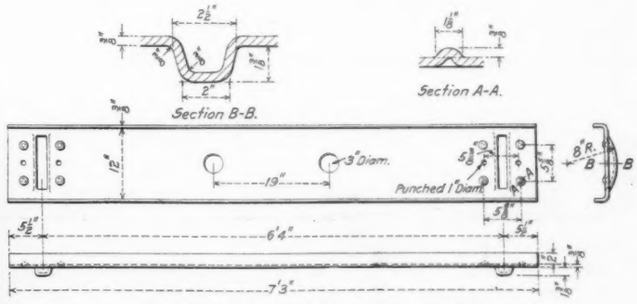
Floor Plan of N. C. & St. L. Caboose Cars



Interior of the N. C. & St. L. Caboose Cars

The trucks have a wheel base of 5 ft. 6 in., 5-in. by 9-in. journals and 33-in. wheels. The truck side frame is of the Scullin type with the Sullivan flexible spring plank. This spring plank, which is shown in one of the drawings, is the invention of J. J. Sullivan, superintendent of machinery of the N. C. & St. L., and was designed for the purpose of making an equalized truck, distributing the weight equally on all journals regardless of the track conditions. It will be noticed that near the ends lugs are formed 1⅜ in. deep, 2 in. wide and with a radius of 8 in. These rest in corresponding grooves in the lower member of the truck frame. With this construction the truck is less liable to derail under rough track conditions than the rigid truck where the weight shifts diagonally on the journals. The truck springs are of the triple elliptic type.

The cars are equipped with the Miner friction draft gear,



Sullivan Spring Plank for Car Trucks

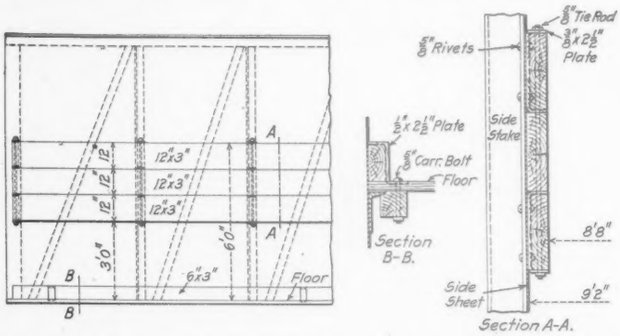
Westinghouse schedule K.C. 1012 air brakes, Sharon cast steel couplers with 5-in. by 7-in. shank, and the National Malleable Castings Company's journal boxes. The Master Car Builders' standards have been used extensively throughout the entire car.

BELT RAIL APPLIED TO UNION PACIFIC ALL-STEEL AUTOMOBILE CARS

The Union Pacific has 600 all-steel automobile cars which were built with the sheathing inside the frame. They were provided with no means of securing shoring for the lading other than the wooden floor, no provision being made for nailing wooden blocks to the side walls on the interior of the car.

A thorough investigation was made of the various methods employed by automobile shippers for applying double deck loads. It was found that each automobile shipper has his own system of double decking, all of which provide for the making up and carrying in stock of certain sizes of timbers and blocks suitable for application to any wood lined automobile car. When the shipper wishes to double deck a car he picks out the several pieces which enter into the construc-

tion of the deck, all cut to size, and secures them to the interior of the car by nailing to the sides. The all-steel automobile cars did not afford nailing facilities on account of the steel lining and the wooden belt rail and floor stringer shown in the drawing were designed and applied to a car.



Wooden Belt Rail and Floor Stringer for Union Pacific All-Steel Automobile Cars

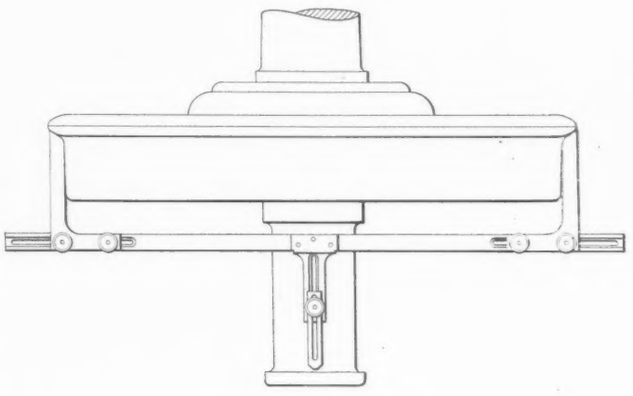
This was passed upon by the shippers and was found to be satisfactory from the standpoint of automobile loading. It is also an advantage in loading other commodities, as it provides means for blocking bulky freight. The arrangement is now being applied to the rest of these cars.

GAGE FOR CHECKING THE LOCATION OF WHEELS ON THE AXLE

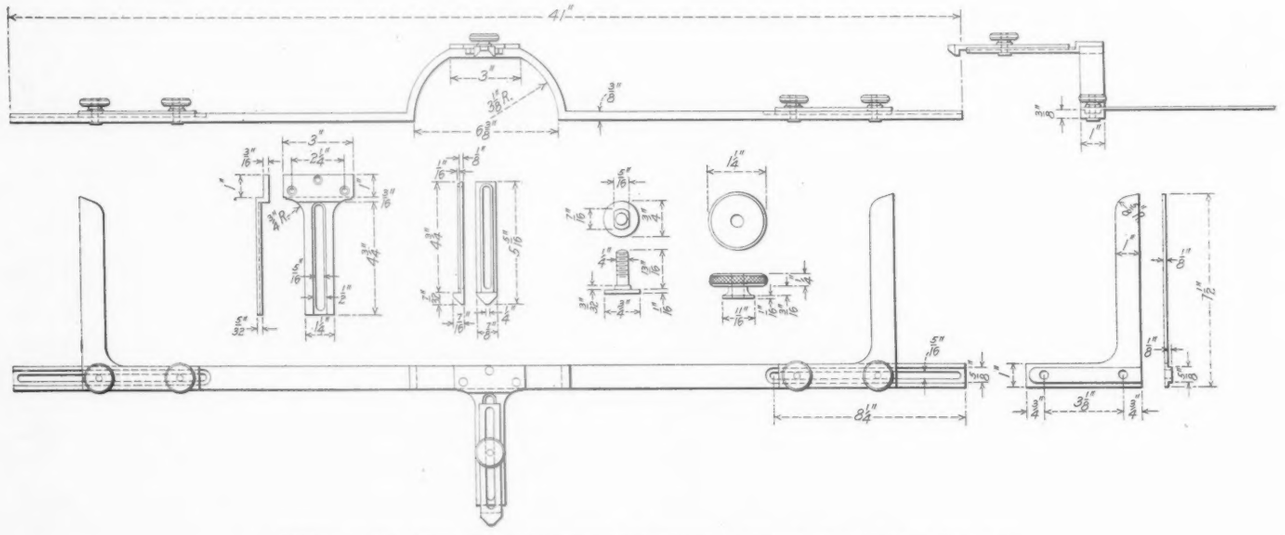
BY HOWARD W. STULL
Machine Shop Foreman, Philadelphia & Reading, Reading, Pa.

A wheel gage has been designed at the Philadelphia & Reading car shops for use in checking up the location of wheels after they have been pressed on the axle, to determine if the distance between the flange and the journal collar is the same at both ends. Many train delays are caused by hot journal boxes and this is often claimed by the car inspectors to be due to the fact that the wheels are not properly located on the axle, the wheel at one end being pressed on too far, while that at the other is not pressed on far enough, thus causing excessive pressure of the collar against the brass at one end and of the fillet at the other. An inspection of the wheels often seems to bear out this claim, as we find that the distance between the journal collar and the flange varies as much as ⅜ in. to ⅞ in. on the same pair. The use of a gage for checking this distance would seem to be the practical means of insuring that the wheels are located symmetrically on the axle when the distance between the wheels is correct. The gage is not intended to space the wheels, but merely insures the proper location of the first wheel relative to the journal, the other one being spaced from this in the usual manner.

Referring to the details of the gage, it will be seen that there are three adjustable contact points, two of which are designed to be placed against the flange of the wheel at diametrically opposite points. These are adjustable on the body of the gage and may be set to suit the diameter of the wheel. The body is offset in the center to clear the journal and here is attached the third point, which is adjustable in a direction parallel to the center of the axle and is designed to be brought into contact with the inner face of the journal collar. The method of using the gage will be readily understood by referring to the drawings, one of which shows the gage applied.



How the Gage Is Applied



Details of the Gage for Determining the Proper Location of Wheels on the Axle

Motor Cars to Archangel.—According to a wireless press message, the Russian military authorities have started a complete service of motor-cars between Petrograd and Archangel to supplement the railway. The road from Petrograd to Archangel, over 600 miles in length, has been newly constructed for the purpose. The cars, most of which are heavy lorries, were supplied from the United States.

CAR AND LOCOMOTIVE PAINTERS

Subjects at Annual Meeting Included Paint Specifications and Steel Passenger Equipment Roofs

THE forty-seventh annual convention of Master Car and Locomotive Painters' Association of the United States and Canada was held at the Breakers Hotel, Atlantic City, N. J., September 12-15, H. Hengefeld, master painter of the Atlantic Coast Line, presiding. The association was welcomed to Atlantic City by a representative of the mayor and the key of the city delivered to the president. In his address, President Hengefeld dwelt on the relations of the members with their superior officers and laid stress on the need for economy under the present conditions affecting wages and the price of materials. The secretary-treasurer reported a membership of 305, which is a gain of 13 over last year.

REPORT OF TEST COMMITTEE

The Committee on Tests, of which J. W. Gibbons (Santa Fe) is chairman, presented a report from which the following is taken:

The committee last year proved by a number of tests that heat treated linseed oil made the best paint vehicle for the protection of iron and steel. We also gave quotations from a number of recognized authorities on paint to substantiate our claims. To further substantiate the proof submitted, we have secured some paints made with the same pigments, but the vehicle in one set was raw linseed oil and in the other heat treated linseed oil. These paints were applied on sandblasted steel plates and when dry, the plates were fastened on the roof of a passenger car.

The plates on which the paint mixed with raw linseed oil was applied are badly corroded. The others are in fair condition. A number of the plates were painted with different compositions of red lead and inert materials mixed with the different oils, but we did not have sufficient exposure to secure definite results. Film tests made of these materials indicate that comparatively the same results may be anticipated. These films were allowed to dry for ten months, then submerged in water for 60 days, taken out and allowed to dry for one week, then submerged for 30 days.

All authorities who have studied the question agree that sulphur fumes and acids from the wash and burning of coal constitute the greatest menace to the proper protection of railroad equipment. Therefore, the committee had run tests to ascertain what composition of paint materials offers the greatest resistance to sulphuric acid. The plates used in this test were each given three coats of paint and when thoroughly dried a 40, 50, 60 and 70 per cent solution of sulphuric acid was dropped on the paint.

This completes a series of tests to determine the relative merits of paint materials for the protection of steel and we believe we have conclusively proved that (1) a heat treated linseed oil is superior to raw or chemically treated linseed oil. (2) Considering service conditions, and price, a composition paint with red lead base is the best paint for priming or under coating, although more or less susceptible to the action of acids. (3) Carbon paints when applied direct to the metal, permit corrosion to form rapidly, but when properly selected and mixed with heat treated linseed oil, make an ideal finishing coat for certain classes of railway equipment, on account of the acid-resisting qualities. [To demonstrate the effect of electrolysis on steel the committee presented a series of photographs showing the interior of a treated water storage tank of the Sante Fe at Topeka.]

DISCUSSION

It was brought out in the discussion that red lead with from 10 to 15 per cent of litharge will give the best service in painting steel cars. The Norfolk & Western has tried pure red lead and has had to purchase litharge to mix with it, in order to get the proper drying qualities. It was the consensus of opinion that the best results in painting steel cars required the removal of all rust.

TREATMENT OF STEEL PASSENGER EQUIPMENT ROOFS AND DECKS

H. HEFFLEFINGER (Penna.).—Before any steel surfaces of a passenger car are painted they must first be made free from scale, rust, grease, acid, etc. There seems to be only one way to guarantee a thorough cleansing of these parts and that is by sandblasting, either before or after assembling, as the use of wire brushes, scrapers and sand or emery paper will not reach all the defective places. To procure the best results after the sandblasting, elastic primers should be used and should be baked on, when it is possible to do so. These primers should be applied to all surfaces where

metal bears on metal before assembling, and all concealed parts, such as the hoods, under surface plates forming the roof, and the ventilators on cars having stationary sash, must receive a second and third coat of paint before complete assembly, preferably by using an approved steel or iron paint of two colors to make sure of safe inspections. The same rule should be followed in painting the top of the roof; that is, it should not receive less than three coats of a well-tried-out elastic mixture.

The decks, deck screens and deck sash should be primed outside and inside with the same kind of material used as a primer on the body. The outside of these parts should then be followed up with two coats of body color (not too flat), and two coats of the same kind of finishing varnish as is applied to the body outside. The painted finish of the inside of the decks and deck sash, after being well primed, depends somewhat on the finish the interior of the body is to have up to the varnish coats.

Omitting this feature, it is evident that to get the maximum wear out of painted surfaces on the interior of steel passenger equipment cars, they must be covered with as slow a rubbing varnish as possible, sacrificing to some extent the finer finish a quicker rubbing varnish would make. Unless this is done a checked surface will develop in a short time.

In my opinion the parts mentioned in this subject must be classed by themselves for the proper treatment and maintenance, for it matters not what condition the paint seems to be on the car body when receiving class repairs, these parts should be thoroughly examined on the exposed or outside portions.

If the roof is badly rusted it should be sandblasted and painted the same as if new. If not badly rusted, it should be gone over with wire brushes and scrapers and given at least two coats of a well-brushed-out elastic paint, the first coat to be applied as soon as practicable after the car is received, so as to allow as much time as possible between coats while the car is held for class repairs.

H. Hengefeld, President, Master Painters' Association

The deck outside, having stationary steel sash, should be scrubbed and the rust cleaned off with scrapers and wire brushes. A coat of primer should be applied when needed, followed up with two coats of color and varnish, using finishing varnish in the color. The crown moulding on the deck, if curved inward forming a spout-like shape, should be beaten with wooden mallets or clubs to loosen the rust and dirt on the inside before painting. I have noticed in some cases this style of moulding and the face of deck bearers on the ends of the inside of steel passenger cars to be entirely rusted through.

Deck screens must be removed from all cars as they pass through the shops for class repairs, so that they can be thoroughly cleaned and repainted; also to give free access to the deck sides for their proper treatment. They should be replaced before the last coat is applied to the roof, and should receive a coat of finishing varnish after they are in place. Deck sash must be carefully gone over and the loose putty or cement removed, or rust will form on the rails and mullions in a short time.

O. P. Wilkins (N. & W.)—There are three elements that must enter into a proper protection for steel passenger car roofs, decks, screens, sash, etc., namely, the preparation of the steel, the quality of paint, and the application of the material. No matter how well the surface is prepared, if the right kind of material is not used, the effort is practically lost; and no matter how well we prepare the surface, nor with what care the coating is compounded, if it is improperly applied, we may look for an early failure.

We have more or less trouble in protecting the upper parts of our steel passenger cars, and the main reason is that we have adopted the same method as that employed in protecting locomotive cab roofs; this method, not being a cure-all, did not produce the same results.

The author believes the first operation is to thoroughly sandblast the surface and prime immediately with a first class primer. It is of the utmost importance that the priming be done before the accumulation of any moisture, otherwise the sandblasting would be of little value. Red lead and raw linseed oil have been adopted exclusively as a primer, as a result of tests, for all structural steel. Having primed the roof, when thoroughly dry, apply three coats of high grade roof paint, allowing ample time between each coat for proper drying. For this operation we recommend a pigment of high oil carrying capacity such as lamp-black, graphite, and finely divided iron oxide.

The hood ends are improved and offer greater resistance to the cinders if the last coat of roof color is given a liberal sprinkling of sand.

For maintaining the steel roof, we suggest that it is of paramount importance to have a thoroughly competent man to inspect the roof at terminals, and when he finds the paint film breaking, he should not lose any time in applying a coat of standard roof paint. Employees reicing and watering cars should be required to wear rubber heels on all shoes to prevent the nails from scratching the painted surface.

The metal frames of deck screens should be thoroughly sandblasted, primed immediately with red lead, and this followed up with a good surfacing system in keeping with the other parts of the car. After the priming is dry, apply one coat of surfacer, knife in the rough places, sandpaper, and apply two coats of enamel and one coat of body varnish. For maintenance, we suggest careful, competent inspection at terminals, and when the occasion demands, apply a coat of enamel. The initial treatment and maintenance of deck sash should be in accordance with the other parts of the car.

Ventilators should be kept well painted and protected from the elements. The initial treatment in the case of galvanized iron or tin should first be a coat of red lead priming, and if black iron or steel is used, they should be sandblasted. After the priming coat has been applied, follow in the same manner as in the treatment of the roof already referred to.

J. D. Wright (B. & O.)—The preservation of the roofs, decks, deck-sash, screens and ventilators, on account of the severe exposure to which they are subjected, presents one of the most difficult problems connected with the painting of steel passenger equipment cars. The heat from the sun, moisture from dew, frost, hail, rain and snow, tend to destroy the life of the paint coatings applied for their protec-

tion. The gases from locomotives, especially in tunnels, are more severe on the roofs, decks, deck screens, etc., than on any other part of the car. The abrasion caused by cinders and in many cases, from the feet of employees while walking on the roofs to fill water coolers, tanks and refrigerators, wears away the protective coatings and in time exposes the metal.

While the subject in hand is on the initial treatment and maintenance of the parts in question, their preservation is so much affected by their construction that it may not be out of place to point out, at the outset, the advantages derived from having plain surfaces to protect, free from corners and pockets where cinders may lodge and collect moisture, and in this manner make dilute acid which acts chemically on the metal wherever it can be reached.

J. Gearhart, Vice-President, Master Painters' Association

Corrosion of steel roofs, decks, deck screens, etc., is the principal cause of their deterioration and the metal in these parts should be protected adequately from the outset, to prevent the corrosion from getting a start. There appears to be a difference in the formation of the corrosion which takes place on the steel roofs as compared with the rust that forms on steel sheets which are in a vertical position. The former seems to start with a pit which gradually extends its circumference and eats its way deep into the metal, while the rust on vertical sheets remains more on the surface. This is probably due to the fact that on the horizontal sheets the moisture, which is always present when corrosion takes place, hangs in the cavity of the pit and accelerates the corrosive action, while the vertical surfaces naturally dry off more readily. We are also inclined to think that many of the pits on the roofs are started by hot cinders which fall on the horizontal parts, burning through the paint and in this manner exposing the metal.

J. W. Gibbons, Vice-President, Master Painters' Association

The steel should, of course, be properly cared for from the time it leaves the mills until the parts are assembled and applied to the cars, and not allowed to rust. During the process of construction, all overlapping joints should be filled in with a thick protective mixture and made watertight. The underside of the roof sheets, the back of all deck sheets, and all hidden parts should be thoroughly cleaned and receive two coats of a good metal preservative paint before being covered up, after which the exposed surfaces are ready for the initial treatment.

The cleaning of the metal is the first and one of the most important steps in the initial treatment. All oil, grease, dirt, scale and rust should be entirely removed before any coatings are applied for the protection of the metal. Benzine will remove the oil and grease, but the sand blast is by far the best means of preparing the steel for the paint coatings. It not only removes the dirt, scale and rust, but also roughens up the surface of the metal so that the priming coat has a better opportunity to hold to the steel.

After the steel has been sandblasted, the next step is to decide the kind, or kinds of paint to apply and the number of coats. I think we can exclude the entire class known as "tar paints" as being unsuitable for this work. Oil paints will give more satisfactory results, but better still are paints made with both linseed oil and varnish in combination, with sufficient volatile liquid to make them dry and work properly. The addition of varnish to the linseed oil makes a paint that will flow better than a straight oil paint; it gives a less porous film, and one more even in thickness.

For the first, or priming coat, we consider it good practice to apply a thin paint carrying a small quantity of very finely ground pigment so that it will penetrate as far as possible into the pores of the metal. The pigment may be oxide of iron and inert material. This coat should be applied immediately after the metal has been cleaned with the sandblast, before there is time for corrosion to form on the freshly cleaned metal, and it should be well brushed during its application.

A. P. Dane, Sec.-Treas., Master Painters' Association

The succeeding coats should have good body, a generous supply of pigment being used in the mixtures. We have found good oxide of iron paints suitable for these intermediate coats. The finishing coat must conform to the standards of the different railroads, but we consider a good lamp or carbon black paint the most suitable, because it gives a non-porous film with excellent wearing properties. This should also be a combination linseed oil and varnish paint, with only enough volatile liquid to make the paint work properly. We have found it good practice to discard the use of body colors on the decks and deck screens and paint all parts one color, black, from body eave moulding on one side of the car to the body eave moulding on the opposite side. This simplifies the painting, especially at terminals.

To overcome the abrasion caused by cinders, also the troubles due to hot cinders falling on the steel roofs and burning out the life of the paint film, we find it good practice to sprinkle sand in the last coat of paint at the initial treatment.

It is now almost a universal practice to apply to the exterior body of new steel passenger equipment cars, from three to five coats of surfacer, two of color, and three of exterior finishing varnish, or a total of eight to ten coats, and our observations lead us to believe the bodies are pretty well protected. The roofs, decks, deck screens, etc., however, get only three or four coats as a rule, though the exposure is much more severe on these parts. From this it would seem that we may be applying more coats than is actually necessary for the protection of the steel on the bodies, and less than necessary on the roofs, decks, etc.

The maintenance of the roofs, decks, deck screens, etc., is

fully as important as the initial treatment, for they should be maintained in such a manner that there is no chance for corrosion to get started. I hardly think it feasible to lay down hard and fast rules stating the exact time in which these parts should be repainted, for on the mountain divisions where there are numerous grades and tunnels, a few months' service may be more severe than a year's service in a prairie country where there are few grades, and no tunnels, or where oil is used as fuel in the locomotives. Again, some cars make considerably more mileage than others. In our opinion, watchful care is more essential than anything else to the preservation of these parts of the car. A paint with only moderate wearing properties, applied at the right time to prevent corrosion, will give better results than the best materials applied at irregular intervals, or after the parts have become corroded.

DISCUSSION

The New York Central has found it best to sand only the curved part of the roof. There is no need of sanding the level surfaces as cinders cut out only on the curved surfaces, sanding the level surfaces helping to carry moisture down to the surface of the steel. The experience of the Lackawanna has been similar. The Pullman Company is sanding its roofs all over, but it is believed that it is poor practice. Attention was called to the weather conditions under which steel is painted having effect on the service of the paint. Priming should not be done when the humidity is great. One member believed that metal should be painted only when it is at a temperature high enough to drive off all moisture. It was brought out that one road uses special pneumatic tools to clean the steel and has abandoned the sandblast. J. W. Gibbons of the Santa Fe stated that the quality of the steel is an important consideration. It must be free from impurities that are aggravated by moisture getting under the paint. It was decided by a vote that it was the consensus of opinion of the convention that it is detrimental to apply sand on the flat surfaces of a steel roof.

TREATMENT OF THE INTERIOR AND EXTERIOR OF TENDERS

A committee report on this subject was presented by W. A. Buchanan (D. L. & W.), chairman. It was stated that many roads do not paint the interior of tenders, but the report dealt more with general practice than with tenders alone, and it was the general opinion that for the exterior some method should be used to thoroughly clean the steel, the sandblast being considered preferable. A good coat of elastic primer should then be used, followed by the usual finishing coats, the process varying on different roads.

DISCUSSION

It was also stated that no paint will withstand the action of the water in tanks and particularly the action of treated water and that the painting of the inside of tanks was considered a waste of time and material. The Santa Fe uses treated water and it has been found that this forms a protective coating on the inside of the tanks, which is a better protective agent than any paint.

REMOVAL OF TRIMMINGS FROM PASSENGER CARS

J. W. Fryer (N. C. & St. L.).—There is no certain method for handling the work of removing trimmings, for the treatment that will prove satisfactory at one time, will not answer the next, although on the same car. For illustration, a private car was placed in the shop with orders that it must be finished the same day. The roof, platform, steps, and all outside iron work were to be painted, trucks and all glass cleaned, the outside of the body cleaned. In a case of this kind, it is not necessary that the trimmings should be removed, for time will not permit, and besides, there would be nothing gained.

Next, considering the same car for general painting, interior and exterior, in a case of this kind, all trimmings should be removed before the car is placed in the paint shop.

I am convinced that considerable trouble is caused by the trimmings not being removed at the proper time. If locks, hinges, sash and blind lifts, etc., are not removed, and properly cleaned, they will later mar the appearance of the car, and their removal will save some time and expense trying to keep varnish and paint off them.

DISCUSSION

The New York Central removes all interior trimmings in painting the insides of cars. E. L. Younger (Mo. Pac.), always insists on the removal of all sash. It was brought out that in washing the interior, care must be taken to prevent water getting through the holes used for screws, etc., after the parts are removed, as it will damage the inside surface of the steel, as well as the insulation. Most members believed that all sash should be removed in making repairs of whatever class and it was the general opinion that all interior trimmings should be removed.

TREATMENT OF LIGHT-COLORED HEADLININGS

F. W. Bowers (Erie Railroad).—The Erie in former years had all wood and pulp headlinings of the first class, through line coaches painted white in flat colors, striped and ornamented in gold, then edged in black and two coats of transparent varnish applied. Afterwards, when dry, they were rubbed with pumice stone and water and polished with oil, leaving an eggshell gloss.

When coaches came in the paint shop at the next two or three shoppings the lining was scrubbed with the rest of the coach and then repolished with oil. In some cases, particularly the panels of the lining where the gas lamps are situated, which were colored by the heat of the lamps, we cut the ornamentations in with the former white flat color and finished as previously.

Since then conditions have changed and simpler and less expensive methods have been adopted. A great percentage of the former decorations are in part and in some cases wholly eliminated. While most railroads adhere to the varnish finish, some few have dispensed with it, applying paint in an enamel form or a color varnish instead, in order to eliminate varnishing and the striping and ornamentation.

I firmly believe that headlinings that are painted white or in light shades should be varnished.

Theo. Himburg (D. & R. G.).—I have experimented to some extent with building up new and repainting old headlinings over old paint, changing the colors from dark to light shades, also using flat color and enamel, and good results can be obtained with either flat color or varnish color. I always finish a varnish color or enameled surface with at least one coat of pale headlining varnish, while two coats of varnish are applied over flat color.

Several years ago I finished up one headlining with enamel and let it go without varnishing. The color was changed from a light green to a dark ivory by applying one coat of flat color, using plenty of varnish as a binder. After the usual method of puttying and sandpapering, a coat of semi-enamel was applied which dried with very little gloss. This was followed with a coat of varnish color which dried with a good gloss. Striping and ornamenting were omitted. This car was shopped again in 15 months, and after the headlining was washed I found that it would not pass with varnishing alone, but had to be repainted and varnished, ways necessary between shopping periods. I brought up sevon account of not having withstood the several washings aleral other headlinings in the same way, except that I finished them with one coat of varnish and from this method, good service was obtained, except that it did not have a very smooth finish.

Just recently it was necessary to place a new agasote headlining in one of our steel coaches. I washed this headlining with gasolene to remove the grease spots and primed it with a lead primer, the vehicle being one-third boiled linseed oil and two-thirds turpentine. This was puttied the following day and after the priming coat stood 48 hours, it was sandpapered and three coats of flat lead, sanded between coats and tinted to an ivory shade, were applied. The last coat was not entirely flat, the liquid being one-third rubbing varnish and two-thirds turpentine, in order to get a smoother surface for the striping and ornamenting. Then two coats of clear elastic varnish were applied.

In order to decrease the shopping period of each car shopped for paint, and in order to economize on account of the increased market price of paints and paint materials, we have resorted to the varnish color method, which is a cheaper way of doing work. When completed it also has the appearance of a cheaper job.

EFFECTS OF WATER AND OIL CLEANING METHODS ON PAINT

A paper was presented by W. A. Buchanan (D. L. & W.) on this subject, in which it was stated that the water which is used in this process should not be considered hot, as it is about 90 deg. and is not over 70 deg. when it strikes the surface. In two years' use at East Buffalo, no trouble has been experienced with painted surfaces due to heat, although there has been some due to wear. The process has greatly reduced the cost of cleaning locomotives and has given no trouble due to hot boxes or other causes of like nature. The interior of the cab is cleaned about every 15 days, and as the engines are always clean, it assists materially in keeping the men clean and facilitates inspection and repairs.

DISCUSSION

J. W. Gibbons of the Santa Fe believed that there was a film of oil left on the varnished surface and favored the use of dry waste on such surfaces or something that will not leave a coating that will catch dust and dirt. He believed the spraying method was entirely satisfactory for the running gear, but not for the jacket and other varnished surfaces. B. E. Miller of the Lackawanna stated that a film does form on the surface and while it is annoying and sometimes obscures the lettering, it is largely due to improper handling and the use of too much oil. It has lately been found practicable on the Lackawanna to occasionally wipe passenger engines with waste to remove this film. Several members considered the process injurious to varnish and paint, while others said that all the trouble lies in the improper installation and operation, they having had trouble at first, but the difficulties having been eliminated with the correction in the use of the machine. It was decided by a vote of the convention that the process was considered satisfactory for the running gear of the locomotive, but detrimental to the painted and varnished surfaces.

RAILWAY LEGISLATION AND ITS EFFECT ON BUSINESS

J. W. Gibbons, Atchison, Topeka & Santa Fe, presented a paper from which the following is taken: Many of the men who have advocated stringent regulation of the railroads are honest and have given expression to their conviction after careful consideration of the question, but a certain class of politicians who are ever ready to influence the minds of the people with the hope that they may ride into power on the wave of discontent they help to create, took advantage of the state of political unrest that prevails in our country, magnified the real grievances and multiplied the imaginary ones until some of the people thought the panacea of all their social and political ills was the confiscation or annihilation of the railroad companies.

The first to feel the disturbed condition of railroad business was the railway employee, then the retail merchant, whose customers could not meet their bills, next the wholesale house and finally the manufacturer and producer.

In spite of the increased mileage and the natural growth of the business of the country, 104,374 men were deprived of the positions that they had on the railroads in 1907. In spite of the great saving this appears to be on its face for the railroads, at the close of the year 1915 there were 20,143 miles of railroads in the hands of receivers, as against 317 at the close of year 1907, and yet, during this period of depression upon railroads, our country has been blessed with good crops, the foreign wars have created an unusual demand for the products of our farms, mines and factories, prices have soared and the expense of operation has increased.

The railroads have used up all their available material, their equipment and track has been worked to the limit and must be renewed if the business of the country is to be handled properly. The indirect loss to the country is immeasurable. Owing to the lack of funds to purchase equipment and build terminal facilities, many of our lines have become blockaded in the last six months, due to the rush of war munitions to the east. How many towns and counties in our country are lying dormant or going back because of the lack of confidence of men with capital in the future ability of the railroads to pay a reasonable return on the investment?

Let us hope that out of the chaos that has brought the railroads of our country to the verge of financial disaster, there will be an evolution that will place them on a firmer business basis and that the people will have a better and clearer appreciation of their work.

SHOPPING PASSENGER CARS FOR CLASSIFIED REPAIRS

H. A. POLHEMUS (Erie Railroad).—At present, equipment is placed in service after a general shopping and after each trip it is wiped off with dry waste, the waste sometimes being dipped into the oil box. This is bad practice. Continuing this practice for a year or more, rubbing the dirt into the surface dries out all the elastic qualities. It kills the finish and puts the equipment in condition for shopping much sooner than necessary. The proper practice at terminals to prolong the life of the finish is to use a good oil cleaner once in six months, rubbing the surface with a bead scrub brush or curled hair, removing all the dirt and wiping thoroughly with dry waste. This will keep the body in a more suitable condition for wiping with dry waste between the oil cleaning periods. If this practice was put in force and carried out to the letter, the shopping period would be more easily determined. Equipment taken care of in this manner would be less expensive to refinish and it would not need shopping under 18 to 24 months, providing a good grade of varnish was used to finish the body. Equipment kept in this condition would need an expert to determine the shopping period owing to the good condition of the finish.

The shopping of equipment should be done in a systematic way by an inspector, and a painter would be preferred, using his best judgment to get the bad cars through the shop first. At present, the transportation department sends the cars to the shop for general repairs, regardless of their condition. Very often cars get into the shop which should remain in service from six to twelve months longer and are stripped and scrubbed before the mistake is discovered. This is poor management and it could be avoided by employing a good inspector, with a saving of considerable expense to the company.

J. A. ALLEN (N. Y., N. H. & H.).—The master painter should have charge of the shopping of passenger cars. He has a complete record of the condition of the paint and varnish on all cars having gone through the paint shop at var-

ious times, and he is familiar with the application of paints and varnishes. He knows after the expiration of a certain time the condition of cars without even seeing them, owing to his familiarity with certain surfaces, colors and varnish used in his department, the quality of materials determining the length of service. He also knows that if he could call in

Fig. 1—Interior of Car No. 4579

cars at a certain period and were allowed to proceed on this plan, he could keep up his equipment with fewer men, less track capacity, and considerably less expense.

M. L. Shaffer (Penna.).—The shopping of passenger equipment should be left to the master painter in charge, inasmuch as the classifying of the equipment is governed by the condition of the paint. He is the one who must be in

Fig. 2—Interior of Car No. 1717

constant touch with the situation, making periodical inspections, and is consequently familiar with the condition of the repairs previously given the car.

Instructions have often been given, to give a car light repairs, when it really required better attention, with nothing more in view than to place the car in service a few days in advance of its allotted time. It might last only about six months, whereas had this work been left to the foreman painter and handled properly, the car could have remained in service from 14 to 18 months. Work of this character only reflects upon the ability of the master painter.

DISCUSSION

It was decided by a vote of the convention that it was the consensus of opinion of the members that the master painter should have charge of deciding what class of repairs is necessary for passenger cars.

THE PURCHASE OF PAINT ON RAILROAD SPECIFICATIONS

W. O. Quest (P. & L. E.).—When a railroad asks a paint-making concern to put its lowest selling price on its own specified formulation for paint, it does so at its own risk, because in so ordering its paint supplies on an open market, the buyer assumes all of the responsibility for quality value. On the other hand, when the railroad buys the guaranteed specialty paint of the reputable railroad paint

Fig. 3—Interior of Car No. 1621

maker at the usual, fair, established market value, there is no buyer's risk. The more I studied this subject, the more I became convinced that it is positive economy for a railroad to buy paint from the specialist maker. As a matter of business, the transaction is safer, because such reliable people have a business reputation to sustain, which, as a rule, they will back up.

There can no one doubt that the term "specification paint" is synonymous with the paint demands of the railroad paint shops that are operated in conjunction with well equipped chemical laboratories. It would then appear that the railroad without a chemical laboratory would be at the mercy of the frenzied competitive price cutting paint maker and seller, who is undoubtedly partially, if not wholly responsible for the unsatisfactory market condition that finally compels the railroad cheap paint buyer to resort to the science of chemistry for protection.

Regardless of the protection of chemistry, or the paint specification mandate, there is always trouble in the railway paint shop for which the foreman is not responsible. When paint, cheap in both price and quality, proves a failure, its maker as a rule will set up the complaint that he is the victim of a shop discrimination or that the shop in question

was either too hot, too cold or too damp to insure the safe application of his paint, which in a fair shop try-out often proves to be absolutely worthless. Now I do not wish to convey the idea that paint innovations should be barred from the railroad paint shop, but I do claim that all such new paint stock, regardless of formulas or specifications, should

Fig. 4—Exterior of Car No. 1775

be tested out for both its working and service wearing qualities so as to leave no doubt of final fitness.

There have been thousands of demonstrations that have taught the lesson that the best paint that can be bought is the cheapest in the long run. As a consequence, it does not matter whether the best paint is a reputable manufacturer's or a railroad specification paint, just so long as the purchasing company gets its money's worth. If the railroad specification paint is the best, let us have it, but not in its hazardous cheapest-in-price form.

DR. M. E. MCDONNELL (Chemist, Penn. R. R.).—If chemists knew the best paint for each particular application, and if they could write a specification for each in such a manner that it could be complied with, and if all paint products not complying with the specifications could be rejected, there would be but one side to the question. A specification informs the purchasing agent and the manufacturers just what is wanted and affords a fair basis for competition, and there is no reason why any consumer should buy something which he does not want.

On the occasion of a recent visit to the factory of a large paint company, which has apparently organized an advertising propaganda against paint specifications, a request came in for a quotation on a large order for paint oil. The railroad sales manager said: "Now what do you suppose is wanted? We can make paint oil covering a wide range of merit, composition and price. We do not know what this prospective customer wants to pay or how to deal with such inquiries." He could have said exactly the same thing with reference to a paint inquiry which was not accompanied by a specification. It would almost seem that the main object in trying to break down paint specifications, is to avoid competition.

It is argued by some that paint specifications retard progress, by fixing standards. Such argument has little weight,

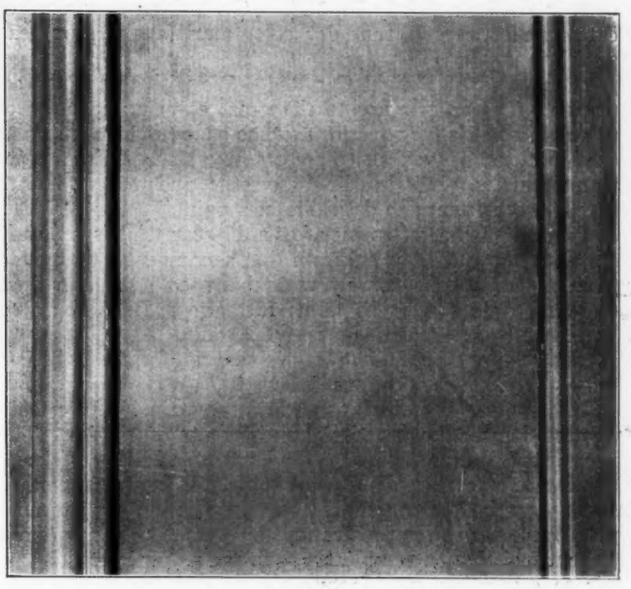


Fig. 6—Interior of Car Shown in Fig. 5

for any paint consumer would change his specification if he were convinced that it would be improved upon. This point is well illustrated by the history of the Pennsylvania Railroad specifications for exterior cabin car color. Prior to 1883 English vermilion was ordered for this purpose, and no tests were made to see what was being obtained, till the condition of the cars led Dr. Dudley to investigate and he found that in many cases no sulphide of mercury was present in many of the shipments. Furthermore, he learned that there was not enough English vermilion on the market to render it commercially available in the quantities desired. He accordingly issued a specification for scarlet lead chromate and tested all shipments to see that they did comply

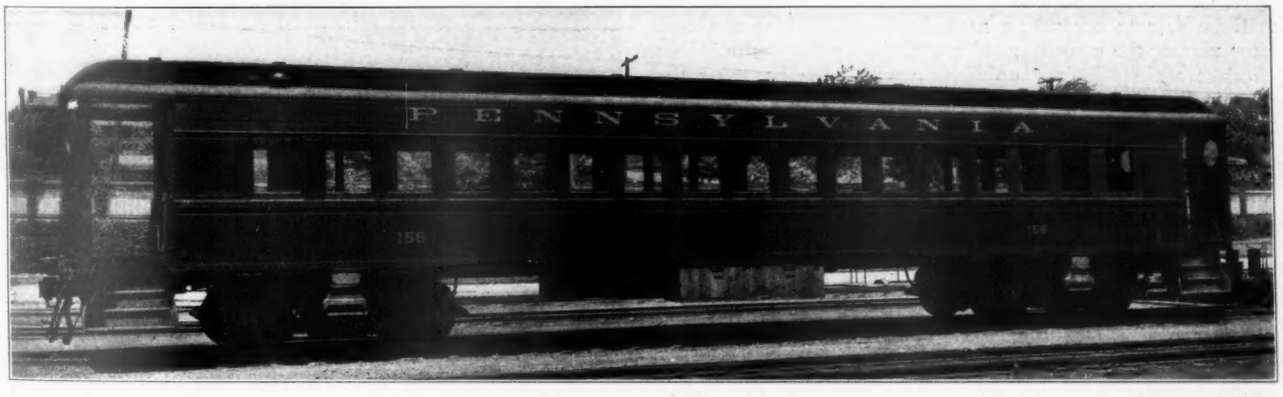


Fig. 5—An Example of the Possibilities of Paint Durability

with the standard designated. After the specification had been in force for a number of years, there was a development in the state of the art of the manufacture of certain organic pigments, some of which had great merit, and in 1911 the company again changed the specification, this time to toluidine red, a product of unquestioned merit. In 1915, war conditions made it necessary to again change, and at this time the use of an iron oxide composition was adopted. The specifications have consistently followed the progress of development, and will continue to do so, but during all of this time, all manufacturers have had a definite basis on which to work.

One of the early paint specifications issued by the Pennsylvania Railroad was for freight car paint, this having now been in force since July 26, 1886. On looking over a recent catalogue of a prominent dry color manufacturer, we read as follows:

"Pennsylvania Freight Car Red.—We wish to call the attention of paint grinders to the great covering capacity of this red, it being far superior to some of the reds made up of combinations of various pigments, by some of the paint manufacturers. It is less liable to settle, and works out with that fine consistency so desirable in a paint."

To read such a statement after a 30-year trial is certainly gratifying, and it is well known that a number of prominent paint manufacturers comply with this specification in their standard trade iron oxide paint; furthermore, it is approved by the Russian Government in their contracts.

It would not be fair to assert that all of the criticism against paint specifications is unjust. In drawing up a specification, it is important to first ascertain by experience what will meet the practical requirements of service. The composition called for should not be unnecessarily restricted. It must be a product readily available. It is also important that the purchaser can make the necessary tests, to compel compliance with the specification. To state what is desired without insisting on compliance with the requirements, is unfair to competing manufacturers, and does not protect the consumer. There is a tendency in certain quarters to write specifications which cannot be enforced. The fact that some specifications are written without due consideration does not condemn a sound principle. It would be just as fair to condemn the practice of medicine because some quack doctor without any knowledge of medicine is allowed to practice.

It is not practicable with our present knowledge to control the purchase of all paint produced on chemical tests. In such cases, physical tests can be devised, which we believe will be fair to competing manufacturers, and at the same time protect the consumer. Varnish is a good example of a product which, in our opinion, cannot now be controlled chemically, yet we believe it is possible to devise a specification under which it can be purchased on a competitive basis. The accompanying illustrations show the necessity for such tests. Fig. 1 shows the interior of a 54-ft. compartment car, No. 4579, completed May 29, 1912, which received class repairs including color on the exterior and varnish throughout which were completed on May 21, 1913. It was photographed February 7, 1915. The car had been in service 1 year, 8 months and 17 days, following class repairs.

Fig. 2 shows the interior condition of a 70-ft. passenger car, No. 1717, completed by another car builder September 1, 1908, which received class repairs, including color and varnish on exterior and interior, which were completed on February 11, 1910. It was photographed about December 1, 1911, after 1 year, 9 months and approximately 20 days service, following class repairs.

Fig. 3 shows the interior condition of a 70-ft. passenger car, No. 1621, which was new January 20, 1910, and was photographed on or about December 1, 1911, after 1 year, 10 months and approximately 20 days service and before it had received any class repairs.

Fig. 4 shows the exterior condition of a 70-ft. passenger car, No. 1775, which was new in January, 1909, received class repairs, including exterior color and varnish which were completed on April 13, 1910. It was photographed on or about December 1, 1911, after 1 year and approximately 7½ months service, following class repairs.

The appearance of these cars is far from satisfactory. Ignoring class repairs, one of these cars had been in service less than two years, two were less than three years old, and the fourth car, which was the oldest, had been built only three years and three months.

Fig. 5 shows what is possible in the way of durability. This car was completed in January, 1913, and photographed 3 years, 4 months and 14 days later, before it had received any class repairs. Fig. 6 shows the interior condition of the same car. With such examples confronting our officers, it was considered necessary to more rigidly control the purchase of varnish. It is but fair to state that this car, No. 156, was painted by the baking process. The varnish was one of four selected from panel tests of a large number of

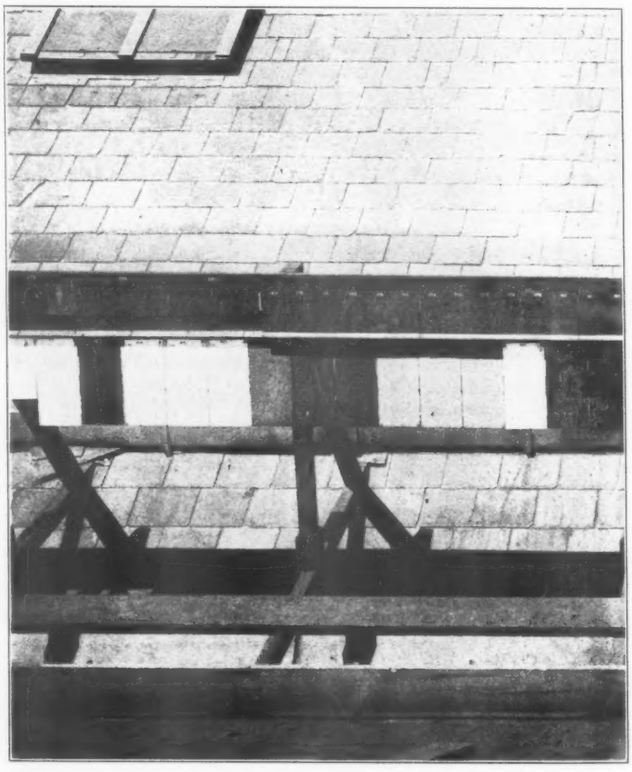


Fig. 7—Method of Exposing Test Samples on the Pennsylvania

baking varnishes. The preliminary tests on varnishes of this class had been elaborate and showed that many of the samples submitted by manufacturers were inapplicable. The result of these trials on baking varnish were so convincing that it was decided to have the same tests applied to other kinds of varnish. A method was accordingly worked out and put in effect January 1, 1915, which we believe gives protection, and while varnishes are now virtually bought on specification, we are confident that the manufacturer is not limited in the exercise of his ingenuity. The fact that a test was started on some 50 brands of varnish this month shows that the method does not prevent competition.

The method is largely practical, the tests being made on standard sandblasted steel panels made from sheet steel which was purchased for the construction of passenger cars. Each panel is 14 in. by 30 in. in size. One side of a large number of such panels is prepared by applying a suitable

surfacing system and two coats of flat Tuscan red, excepting a space 3 in. by 30 in. at one edge which is left bare. Each panel is then laid off into six sections, and each section is numbered consecutively, the figures being white, and a white stripe is applied lengthwise across the panel over the Tuscan red. The object of the white stripe is to make possible a better judgment of the color of the varnishes under test, dark varnish being objectionable. A number of such panels, estimated to be a year's requirement, are prepared at the same time and kept in stock till they are required. The varnish samples to be tested are divided into groups, made up of the various classes which are used. It is desirable to have six samples of the same kind of varnish. In every case, a standard sample should be included, as the results obtained will vary more or less according to weather conditions, the test being comparative. Three coats of each sample are applied to the assigned test panel section, at intervals of 48 hours. After the third coat has stood for 48 hours a portion of each section is rubbed, excepting finishing varnish. Rubbed sections are observed for a period of 24 hours for "sweating out" defects. It might be said that throughout the application of the sample being tested, notes are made of any defects in color, drying properties, flow, etc. On the third day following the application of the last coat of varnish, all test panels are placed in a vertical position on a rack having a southeastern exposure, and observations for checking are made at intervals of two or three days. As previously stated, it is imperative that each class of varnish under test be accompanied by a standard sample, as the time of checking will depend somewhat on weather conditions, but if this precaution is taken, the relative time of checking shown by the different brands of varnish is a fair measure of their relative durability.

In the purchase of varnish, it is our practice to place requisitions for any of the brands which are on an approved list. Samples from all shipments received are tested, and if the quality is found to be below "standard" such brands are dropped from the approved list and purchase of them discontinued. New brands of varnish are also added to the approved list from time to time, after the test as outlined has shown them to be entitled to this recognition. Fig. 7 shows a portion of the test rack as it existed on September 1.

We believe it is possible to formulate and apply specifications for the various classes of paint products, including varnish, which will be a stimulus to greater effort on the part of the manufacturers, and which will reward them for creditable efforts. The consumer will also reap the benefit of such improvement, and the painter will feel better satisfied with his work, especially if he has the opportunity of seeing it after it has rendered several years' service.

PAINTING OR OILING THE INTERIOR OF STEEL HOPPER CARS

J. GRATTON (B. R. & P.).—Corrosion starts principally from the interior of the car, eating its way through the floor, hopper and side sheets, making necessary the shopping of the car to renew the sheets. On account of the present high cost of labor and material this is a very expensive operation. Furthermore the loss of revenue resulting from withdrawing the cars from service when so badly needed is large.

On the Buffalo, Rochester & Pittsburgh, to determine the benefits which would be derived from coating the interior of the cars with oil, we arranged some time ago when cars were shopped for exterior painting or were undergoing heavy repairs, to thoroughly clean and remove all scale and rust from the interior of the car by the use of the hammer and by blowing out with a compressed air jet. The sheets were then given a coat of oil with a paint spraying machine. The cars, after being put back in service, were periodically examined and we found that the oil evaporated very quickly, resulting in very little permanent benefit. At present we are experimenting with more cars, applying a coat of elastic paint with the spraying machine. We find the machine to give better results than can be had applying the paint by hand with a brush, as the corners and crevices around the rivet heads are better filled and all openings at the seams are penetrated by the paint spray. We find this practice to have some advantage and as long as the paint or oil lasts it retards the wasting away of the sheets. When we examine the cars which we have oiled or painted, after they have been loaded, we find that much of the paint has been rubbed off in service by the loading and discharging of the lading. However, the principal wear is on the broad faces of the sheets and if the cars are kept constantly in service this wearing has a polishing or scouring effect which helps to offset corrosion. If we direct our attention to the seams, corners, etc., and around the rivet heads, which are the vital points, we find that the same scouring effect is not noticeable, and that unless the coating has well protected the parts there will be a mass of rust and scale which constantly and slowly will destroy the steel, whether the car is in service or not, greatly weakening the structure and diminishing the life of the car.

DISCUSSION

In reply to a question by J. W. Gibbons of the Santa Fe, the author stated that the oil used is a Pennsylvania oil with a paraffine base. Mr. Gibbons stated that he believed it would be desirable to have tests made, using an oil which had an asphalt base. The cost for labor in doing this work on the Buffalo, Rochester & Pittsburgh is 28 cents per car. A committee was appointed to continue investigations on this subject. W. O. Quest (P. & L. E.) said that paint is of no use for the protection of the insides of steel freight cars, as it either burns or wears off. The Norfolk & Western has applied oil with a spray for protective purposes, and has lately changed to painting, using one coat of red lead and one of carbon black.

VARNISH REMOVER FOR REMOVING PAINT

GEORGE H. HAMMOND (Soo Line).—Varnish remover, as it is now made, is a marvel of efficiency as compared with the product of a few years ago. It was then a crude, pungent, slow acting and expensive material. It was a menace to the health of those who used it in confined places. Many master painters were prejudiced against it, believing it would cause trouble to the coats applied over surfaces where it had been used.

The manufacturers of such removers have been constantly striving to perfect their product and have succeeded so well that little fault can be found with the present day product, and it is considered an absolute necessity in every paint shop. Removers which soften varnish and paint rapidly, but evaporate slowly and do not separate or settle, are found to be the most economical and efficient. With the use of proper appliances, such as spray machines, vacuum machines and specially constructed brushes, both hand and power, maximum efficiency is obtained. Thus equipped, and with skillful labor, the paint on the wall surfaces of the interior of a steel passenger car can be removed at a cost of 50 cents per foot of car length, 60 per cent of this being expended for labor and 40 per cent for material.

Taking the outside of a steel passenger car into consideration, we find that the cost to remove the paint with varnish remover is practically the same as the inside. The ratio of expense for labor and material is different, as it requires less labor but more material; 45 per cent goes for labor and 55 per cent for material. This estimate applies to steel plate construction with the rivets exposed.

In shops where the necessary facilities are installed, a quicker and less expensive way to remove the paint from the outside of a steel passenger car is by sandblasting. The cost is 7½ cents per foot of car length for labor. Sand, air

and wear on sanding equipment, will be approximately 2½ cents, making in all 10 cents per foot of car length, or $8 for an 80 ft. car, a saving of 80 per cent of the cost of removing with varnish remover. These figures will, of course, vary.

It is not practicable to use the sandblast on the interior surface of a steel passenger car, owing to the confined space, great accumulation of dust and inability to blast such parts as need it without damaging parts which do not need it. Also, the steel itself is so thin that there is danger of buckling or even cutting through weak places. Neither should the outside of a steel passenger car constructed in imitation of wood sheathing be sandblasted; the steel is too thin to stand it, but the thick plate construction will stand many sandblastings.

DISCUSSION

The Santa Fe has successfully used the sandblast method for cleaning cars with the finish made in imitation of wood. The cost is 7.1 mills per square foot and as this is a beaded surface, this cost is probably a little more than would be necessary on a smooth surface. O. P. Wilkins (N. & W.) doubted if the sandblasting described by Mr. Gibbons could be carried out many times, as it would wear out the metal. In reply Mr. Gibbons stated that this has been considered, but the amount of metal removed is so small, that the car can be sandblasted probably four times without injury. It was decided by a vote that it was the consensus of opinion of the meeting that there is nothing superior to varnish remover for use on the inside and sandblasting for use on the outside of steel cars for removing paint.

USE OF SOAP IN CLEANING PASSENGER CARS PREPARATORY TO VARNISHING

W. Mullendorf (Ill. Cent.)—Both soap and water vary in quality for this purpose. "Hard" water will deposit lime by contact with soap and make a lime-soap combination, very irritating and destructive to varnish. Soap, in commercial form, carries a caustic or potash base, both of which are the natural enemies of paint and varnish and are active solvents of them. Soaps will have the same effect as lye in a modified form. To be more effective than plain water, soaps must be powerful enough and used in sufficient quantity to precipitate the limes in water in order to produce softening, leaving a surplus of alkali strength to decompose the various dirt deposits on the surface of the car. The alkali deposits left from wash water lead to spotting and changing of color.

Practically the same action takes place from the use of soap in "soft" water. So-called neutral soaps that show no free alkali are rare and entirely too expensive for car cleaning so that the field of soap and water cleaning is limited to those soaps that generally affect the skin of the operator and in like manner the skin of the varnish or paint.

The action of soap and water cleaning is particularly noticeable on paint, which it gradually washes away. Varnish is more resistant to this action of soap and water because of being harder, but its gloss is reduced with each washing and checking follows rapidly, depending on the strength of the alkali.

The absorption of oils from either paint or varnish is known as weathering, and is done by the atmosphere or alkalies, or both, and leads to cracking or checking of the surfaces. Alkalies accelerate this destructive action by lodging in the multiplicity of checks. It will be seen that thorough rinsing after the use of soaps is highly important.

In the washing of cars it is important to feed the varnish or paint, and not gradually extract the life of these coatings, as is done by the use of soap, caustic potash, sodas or other alkalies, all of which are deadeners to the finish. A car cleaner, to be economical, must therefore be harmless to paint or varnish and free from alkali, otherwise its repeated use will hasten the car to the paint shop and make it unattractive in the meantime.

The best car cleaning compounds are based on varnish-feeder, non-alkali, non-injurious lines. Those most in use are based on gums made up in the form of emulsion. These cleaners are applied with a large hand brush and owing to their consistency, remain on vertical surfaces without running off. A few minutes time is allowed for soaking the dirt, after which the surfaces are scrubbed with ordinary scrub brushes and rinsed off with water. Wiping with chamois skin brings out the polish, although this is not necessary. After this treatment, varnished or painted surfaces dry without the streaks common to soap cleaning. Surfaces thus cleaned have no tendency to collect dust.

From the fact that surfaces of cars are often not well rinsed after scrubbing, the nature of the cleaner used is highly important. Soap has a blooming and dulling effect upon varnish. The residue left on surfaces from alkali absorbs moisture from the atmosphere, and moisture collects dust, making more frequent cleaning necessary and incidentally more painting and varnishing. A standard gum cleaner enters the numberless pores and checks of the varnish and acts more or less permanently as a filler or "feeder."

The general use of pumice in connection with soap and water for car cleaning acknowledges the inefficiency of soap. Pumice becomes the main cleaning factor and is efficient for the purpose, but destroys gloss and removes a thin skin of the finish with each application. It is also difficult to remove by rinsing and usually leaves the finish with a grey effect out of harmony with the color scheme of the car.

DISCUSSION

The New York Central uses for cleaning cars preparatory to varnishing a solution of muriatic acid, followed by a weak soap solution and pumice preparatory to painting. This does a very thorough job with a decrease in the labor necessary. The strength of the acid is varied according to the condition of the cars and is never less than three parts of water. For general use, nine parts of water to one part of acid was recommended. The Denver & Rio Grande washes all cars every 60 days with oxalic acid and renovates them. On the Santa Fe it is considered that if the soap used is good and is properly handled, it will give satisfactory results. It was also brought out that the success obtained with acid cleaners depends largely on the manner in which they are mixed and used.

OTHER BUSINESS

F. W. Brazier, superintendent of rolling stock, New York Central, addressed the association and made a number of encouraging remarks intended particularly for the younger men, not only the painters, but employees of the car department as a whole. He referred to the fact that the car department is recognized as it should be on but few roads and that its men should be just as eligible to promotion as men who are engaged in locomotive work.

Chicago received the greatest number of votes for the next place of meeting. The following officers were elected for the ensuing year: President, John Gearhart, Pennsylvania Railroad; first vice-president, J. W. Gibbons, Atchison, Topeka & Santa Fe; second vice-president, E. L. Younger, Missouri Pacific; secretary-treasurer, A. P. Dane, Boston & Maine.

Advantages of High-Velocity Steam Piping.—The advantages of small, high-velocity steam piping are: Lower first cost for pipe, valves and covering, etc.; less erecting and maintenance cost; less weight; less radiation loss; less chance for water to accumulate; and less difficulty with valves of smaller size.—*Power.*

Shop Practice

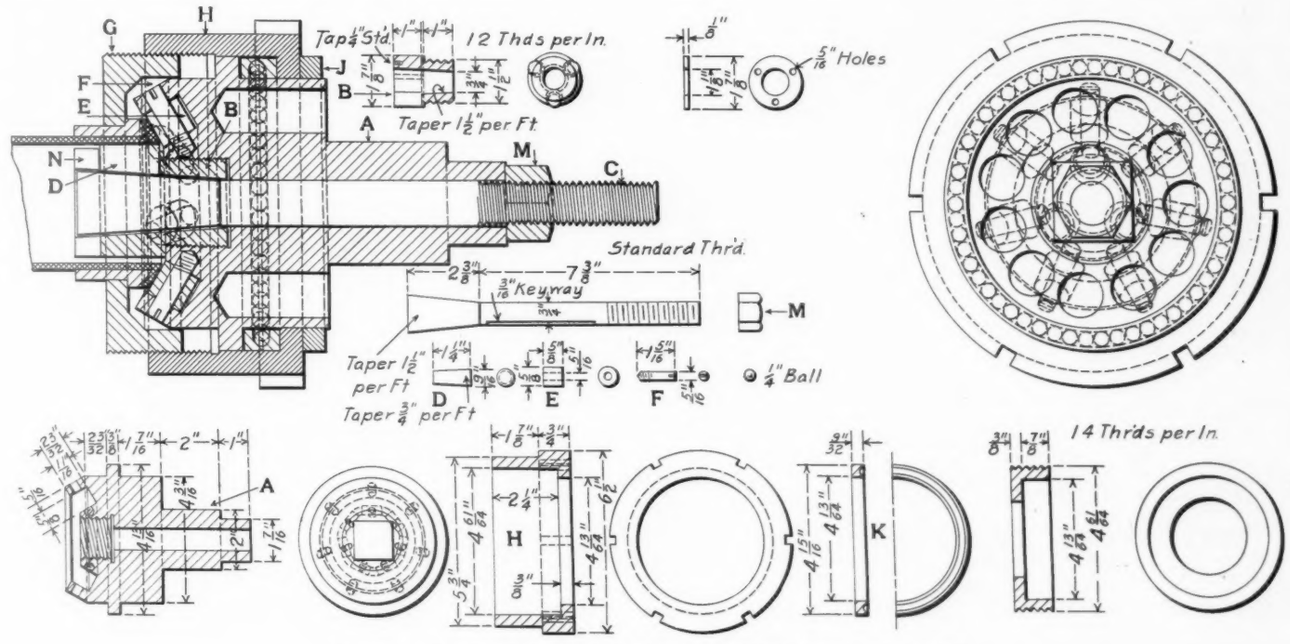
INJECTOR STEAM PIPE ROLLER AND EXPANDER

BY R. J. HETTENBAUGH
Apprentice Instructor, Big Four, Mt. Carmel, Ill.

The illustration shows a small hand tool in the form of a roller for the new type of injector steam pipe joint which is being quite generally adopted. The non-brazed joint is shown in the cross section of the tool and consists of a brass collar over which the copper pipe is bent and rolled down to form the joint.

The joint is formed in the tool by tightening the spanner nut *H* on the split collar *G*, which presses the rollers *E* against the copper. The body *A* then revolves on the ball race *K* which lies between the collar on the body and the nut *H*. The nut is held in place by the small collar *J*. The taper pin *C* revolves with the body *A* through a keyway. By drawing up on the nut *M* the rollers *D* are expanded against the inner periphery of the copper pipe and prevent it from being forced away from the sleeve.

The tool can be operated either by hand or by attaching an air motor, as desired. It weighs 20 lb. and can be made at a very low cost. It has been in operation at the Big Four shops at Mt. Carmel for several months and is giving very satisfactory service.



Section and Details of Tool for Forming Injector Steam Pipe Joints

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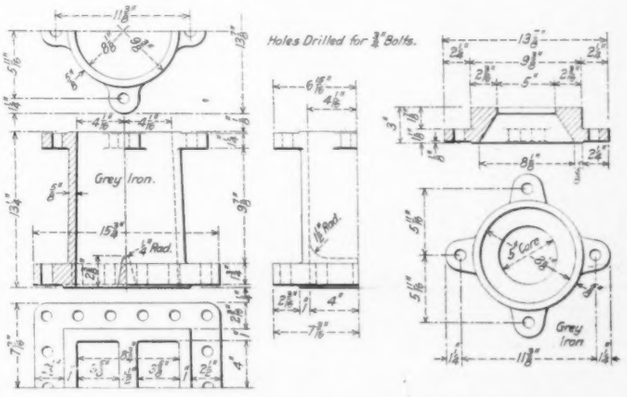
WEIGHT OF CONDENSING WATER.—In condensing steam it is customary to use about 27 to 30 times as much injection water (by weight) as the steam to be condensed; the temperature of the hot water should not be above 120 deg.—*Power.*

UNION PACIFIC EXTENSION EXHAUST PIPE SEATS

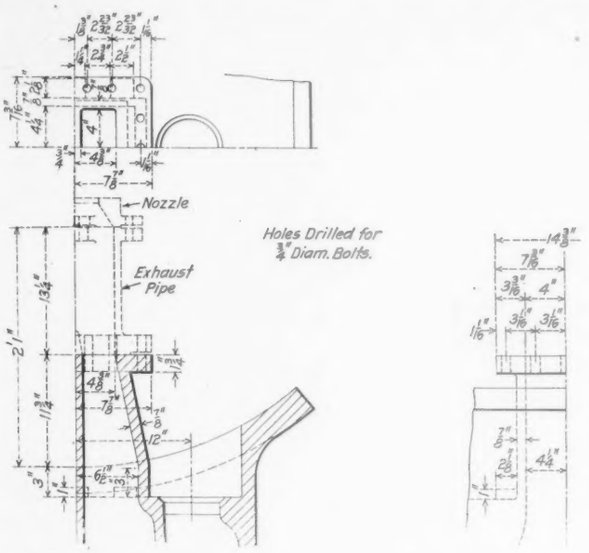
The usual method of securing exhaust pipes to a seat on the cylinder by means of studs or tee-bolts is a very difficult joint to maintain when the exhaust pipe loosens and leaks at the seat. To provide a better fastening and make repairs to the joint easier on account of a more accessible location, the extension seat and flange shown on these drawings was designed and has been placed in service on several engines on the Union Pacific.



Exhaust Pipe Used with the Extension Seat

This consists of an extension of the cylinder exhaust passages to a point 11¾ in. above the smokebox flange, thus

making the lower portions of the exhaust pipe integral parts of the saddle castings. Above this is bolted a short exhaust pipe. The flange, with its through bolts all around the seat,



Exhaust Pipe Seat Extension in Use on the Union Pacific

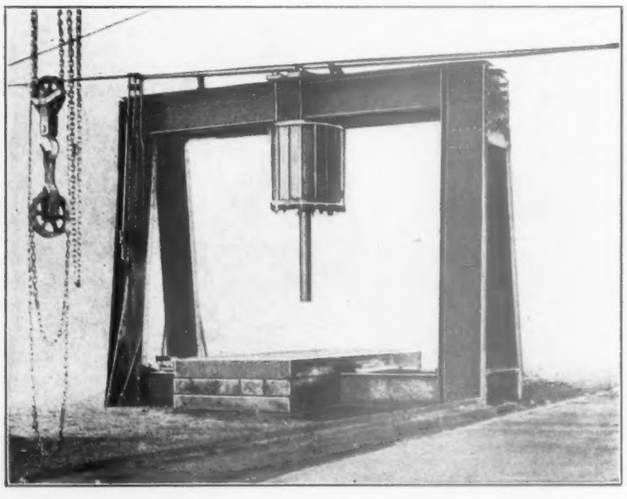
gives a very secure fastening and the joint requires practically no attention.

By casting the cylinders with the original bosses, as well as the extension, in case of damage to the extension it is still possible to continue the cylinders in service by using the original exhaust nozzle.

STRAIGHTENING PRESS FOR STEEL CAR MEMBERS

BY W. H. HAUSER
Mechanical Engineer, Chicago & Eastern Illinois, Danville, Ill.

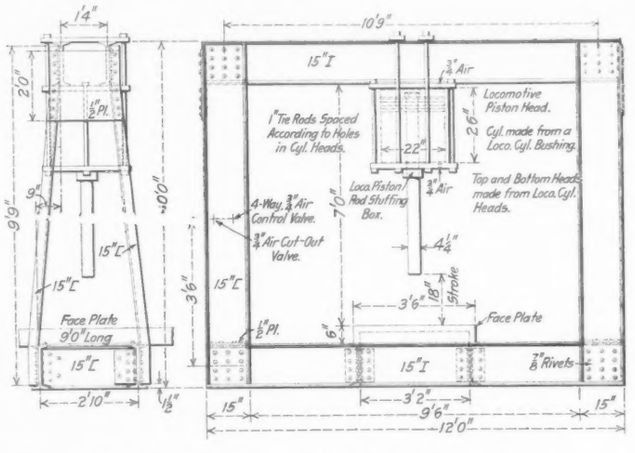
The use of jacking stalls in handling bent and twisted steel on freight and passenger cars, while such cars are still on their wheels and not torn down, has for some time been an established practice. They undoubtedly fill a much



Straightening Press Used on the Chicago & Eastern Illinois

needed requirements, but the work they handle is limited to straightening parts on a car and does not include parts that have been cut off and require attention. Their use is limited to the heavier parts of the car that are bent or twisted. Short members or odd-shaped or peculiarly located members cannot be handled in this manner, but must be cut off and, as a rule, heated in order to be straightened. The work required in straightening bent and twisted steel car members after they have been cut from passenger or freight cars has increased to such an extent in most large shops that the straightening of them over a coal or wood fire and with the ordinary blacksmith tools has become an expensive part of steel car repairs. Railroads have built home-made presses of various sizes which are operated by means of compressed air and quite frequently they have been only of sufficient capacity to handle the lighter steel car parts or to act as a holding press rather than a straightening press.

The Chicago & Eastern Illinois recently investigated this matter quite thoroughly and after checking over several home-made designs in service in different railroad shops, the one shown in the accompanying drawings and photograph was designed. This press was built to handle the heavy side sills, center sills, end sills and other large or odd-shaped parts of steel cars. It was made from scrap channels and I-beams taken from a destroyed bridge, which otherwise would have been sold as general scrap. It was built at the Danville shops at a very reasonable cost. This press, with its 22-in. diameter air cylinder, is 9 ft. 6 in. between the housings which is wide enough to allow a crew of three men

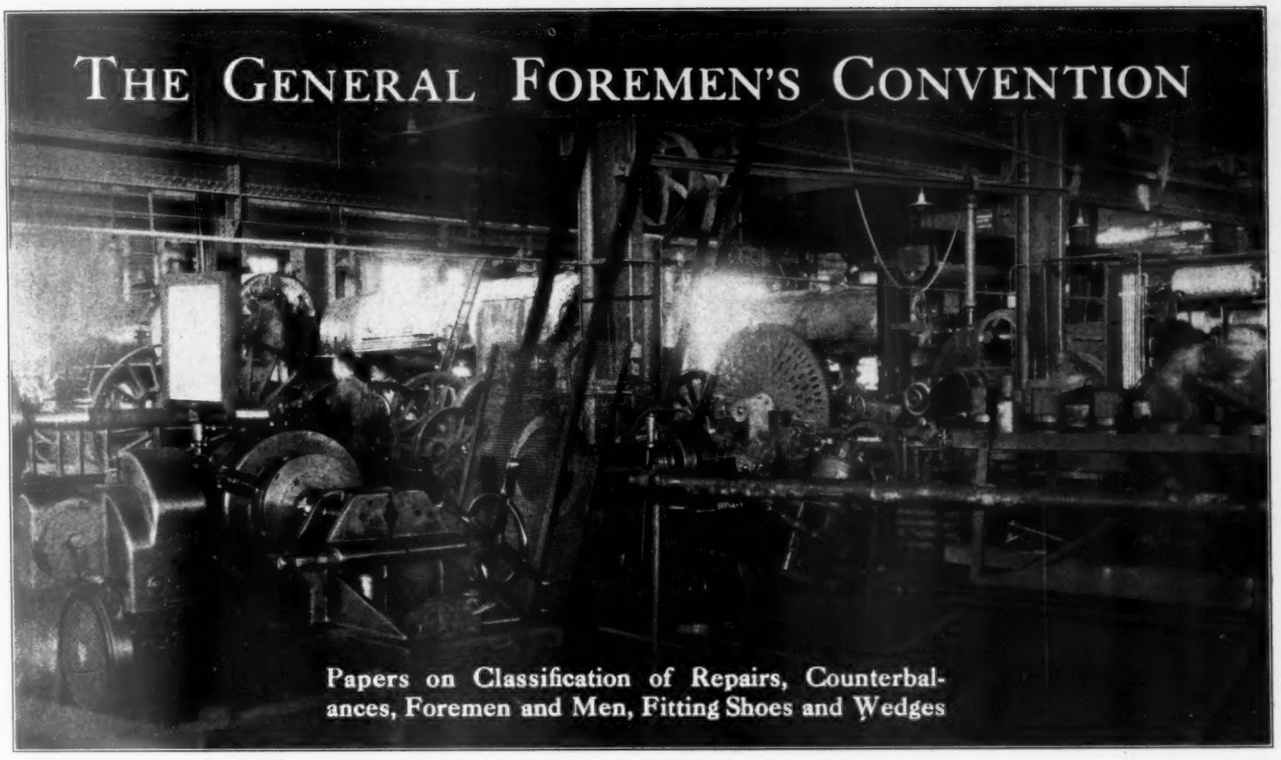

Face Plate 9'0" Long
Face Plate
Locomotive Piston Head.
Cyl. made from a Loco. Cyl. Bushing.
Top and Bottom Heads made from Loco. Cyl. Heads.
4-Way ¾" Air Control Valve.
¾" Air Cut-Out Valve.
Loco. Piston Rod Stuffing Box.
Stroke

Details of Construction of the Straightening Press

to work without any interference with one another. The men can swing a sledge on either side of the press with no difficulty. The operation of the press is very simple. A four-way valve controls the supply of air for the cylinder. The face plate is 3 ft. 6 in. wide by 9 ft. long and serves as an accurate surface on which to gage and check the straightening of the bent or twisted members. Almost anything can be handled on this press. Badly bent center sills or side sills ordinarily can be straightened without heating. When necessary to heat the work a wood fire is used. Pressed steel body bolsters are heated and straightened in one-third to one-fifth the time they could ordinarily be handled without the use of the press. Various brake beam truss sections can be handled, as a rule, without even heating. Most peculiar and odd-shaped bends and twists can be easily taken out from the various car sections. The results obtained from this press are far greater than was expected when it was first built. It can be built at a very reasonable cost and can be easily duplicated by any railroad shop.

WATER POWER IN RUSSIA.—Russia's available water power in Europe, including Finland, the Ural district and the Caucasus, is said to be about 10,000,000 kw., or over 13,000,000 hp., only about one-fortieth of which is at present utilized.

THE GENERAL FOREMEN'S CONVENTION



Papers on Classification of Repairs, Counterbalances, Foremen and Men, Fitting Shoes and Wedges

THE twelfth annual convention of the International Railway General Foremen's Association was called to order by the president, L. A. North, on Tuesday morning, August 29, 1916 at Hotel Sherman, Chicago. After prayer by Doctor Frank W. Gunsaulus the association was welcomed to the city by Daniel Webster, the response of the association being made by W. W. Scott. President North then delivered his address. He said in part as follows:

This association was formed for educational purposes and in the selection of subjects this point has not been lost sight of. We realize that it is only by the careful study and the expressions of the members that the points are brought out which are of value in the handling of men and materials. It is also well to keep before the members of the association the idea that their advancement and promotion depends upon their ability to look ahead and prepare for the future. As general foremen, you are leaders; the examples you set will largely govern the actions of your subordinates. By using tact and good judgment you can secure their confidence and loyalty.

After a brief address by Dr. Angus Sinclair in which he spoke of the important part which the influences surrounding the apprentice have in his success in after life, the secretary-treasurer presented his report. The association has a total membership of 229, of which 200 are active members; and there is a balance in the treasury of $86. Secretary Hall called attention to the growing influence of the association, and as proof of this stated that requests have been received for copies of the proceedings from Tokio, Japan; Bolivia; Peru; Manchester, England, and from South Africa.

On Wednesday morning the association was addressed by Frank McManamy, chief boiler inspector of the Interstate Commerce Commission. The following is an abstract of Mr. McManamy's remarks:

MR. M'MANAMY'S ADDRESS

The purpose of the regulations or inspection rules which were established as provided by the locomotive inspection law of March 4, 1915, is to more definitely show when a locomotive is "in proper condition and safe to operate" as required by Section 2, and to guide the railroad company and its employees and the federal inspectors so their compliance with and enforcement of the law may be along uniform lines. Broadly speaking, the law requires locomotives to be maintained in "proper condition and safe to operate" and provides for an organization to see that it is complied with. The rules are more specific and definitely fix the responsibility for the performance of certain tests, inspections and repairs required by them. I shall not attempt to explain or define each rule, but will try to make clear those that are somewhat general in their terms and with respect to which numerous questions have been asked.

Rule 2 is identical with rule 7 of the boiler inspection rules. It definitely fixes the responsibility for failure to make inspections as required by the rules and requires the mechanical officer in charge at each point to know that inspections and repairs are made in accordance with the rules.

The general purpose of rule 4 is to require the present practice of inspecting locomotives daily to be continued and to avoid, if possible, the necessity of requiring additional sworn reports of inspection. Form 2, which is required by rule 4, was intended to accomplish two definite purposes: first, to insure an inspection of each locomotive at certain prescribed periods; and, second, to require the foreman or officer in charge to know the condition of the locomotive, and to say why defects reported were not repaired before the locomotive is returned to service.

This rule will assist in definitely fixing the responsibility for operating defective locomotives. It will also require the foreman to exercise more careful supervision over the work, so that he may properly sign the report. These inspection reports must be filed in the office of the railroad company where they can be checked if necessary.

I have no doubt that many of you feel that these rules have placed additional burdens upon the foreman, but such was not the intention and a proper observance of them will

result in just the opposite. They will require each man to shoulder the responsibility that rightfully belongs to him.

If the foreman uses the report as was intended and makes it show the exact reason why repairs were not always made, the responsibility will be placed exactly where it belongs. If proper material is not provided, or if the appropriation is exhausted, or if the transportation department refuses to let him hold the locomotive, that fact should be noted on the report so that it may be considered in determining the reason why the repairs were not made. If the foreman attempts to cover up all such conditions by showing repairs made, which, in fact, were not made, he will be shouldering a burden that he will soon find himself unable to carry.

The locomotive inspection law has not been in force long enough to show any material results. In fact, during the first year or two that any such law is in force the principal thing that can be accomplished is to investigate accidents and classify the causes so that we may determine just what remedies to apply. Enough data have already been obtained, however, to justify a word of warning and advice with respect to the inspection and repair of certain parts where in the interest of safety former practices should be improved. Draw gear between the locomotive and tender, including safety chains or bars with their fastenings, should be frequently and carefully inspected, 22 accidents resulting in 2 killed and 21 injured having already been reported due to failure of the draw gear.

Reversing gear has caused 38 accidents, most of which could have been prevented by proper inspection and repair and by providing sufficient clearance around the reverse lever to prevent injury when handling it.

Failures of rods and crank pins have caused 23 accidents, resulting in 1 killed and 25 injured. There is no doubt that a better method of inspecting these parts can and should be followed, although it must be admitted that the defects which cause failures are usually of a character which are difficult to detect. However, better maintenance of rods and boxes will do much to prevent such defects from developing and thereby aid in preventing accidents.

Failure of springs and spring rigging, which is frequently said to be of little importance from a safety standpoint, has killed 2 and injured 7 since such accidents have been reported to us. These parts should be given more attention and in no instance should a washout plug with a projecting square head be used where it can be struck by springs or equalizers in case of failure. Many similar matters might be enumerated, but enough has been said to direct attention to the causes of some of the most frequent and serious accidents and to give a general idea of the purpose and scope of the work of the Locomotive Inspection Bureau.

L. A. North, President, General Foremen's Association

CAR DEPARTMENT PROBLEMS

An abstract of the paper on this subject was published in the September issue of the *Railway Mechanical Engineer* on page 453.

DISCUSSION

The paper and the discussion all indicate a growing appreciation on the part of locomotive department foremen of the importance of the car department. As the general foreman of the locomotive department is usually in line for promotion to the position of master mechanic he should endeavor to become familiar with car department matters by keeping in touch with the car foreman. The work of the car department not only involves the actual mechanical work of repairing cars, but also requires a knowledge of the Master Car Builder's rules, the safety appliance standards, rules for loading material, etc., concerning all of which the general foreman should acquire some knowledge.

It was brought out that the work of the car department in expediting the movement of cars may often be greatly facilitated by the locomotive department. The majority of car repair shops or repair yards are not very well equipped and must depend upon the locomotive department for much of their blacksmith and machine shop work. While it is natural for the general foreman to be more interested in the output of his own department he should not overlook the fact that lack of proper co-operation with the car department often results in delays of from eight to ten hours to cars under lading, because the work required by the car department was not given the attention it deserves. The opinion was expressed that sufficient interest has not been taken in the subject of car department apprentices. An apprenticeship system is needed to develop the right kind of material for foremen in this department.

Several suggestions were made for the prevention of hot boxes. A case was mentioned in which considerable trouble from hot boxes was found to be due to the practice of the car repairmen of putting new wheels in service without scraping the paint off the journals. It was thus impossible to detect slight burrs or rough spots which might be on the journals, before they were placed in service. By scraping off the paint and inspecting the journal it is possible to smooth up any rough spots which may be found, with a file and emery cloth, this practice having resulted in a decided reduction in the number of hot boxes. The importance of rolling the surfaces of the journals after they are fitted was emphasized. Where this practice is not followed the surface of the journal will be smooth in one direction, but slightly rough in the other. If it is known in which direction a car to which the new pair of wheels is applied, is going to run on its next movement the probability of hot boxes can be greatly reduced by placing the wheels under the car so that the journals will run in the smooth direction.

LOCOMOTIVE COUNTERBALANCES

BY H. E. WARNER

Superintendent of Shops, New York Central West, Elkhart, Ind.

There are two forms of driving wheel counterbalance in general use—the style commonly used on wheels of large diameter, where it is possible to obtain sufficient weight far enough from the center of the wheel to obtain the required balancing effect, is the one cast solid with the wheel centers. On wheels of small diameter, where it is impossible to obtain enough weight in the required space, the counterweights are cored hollow and then filled with lead. It is the practice in some of the large shops to pour the lead

into open chambers, which are covered with a steel plate bolted on, or the core holes are tapped and plugged. This prevents any possibility of the lead being lost out or shaken loose and rattling around as the wheels revolve, which might occur in the case of improperly cleaned and filled closed chambers.

This weight in the wheels must balance all the revolving parts, and a portion of the reciprocating parts. The greater the proportion of reciprocating parts that are balanced, the smaller will be the longitudinal disturbance of the engine, but the greater will be the vertical disturbance. This unbalanced vertical component causes the pressure of the driver on the rail to vary during its revolution, and if the engine is running at high speed the effect on the rail is like the blow of a heavy hammer. On the other hand, if too little of the reciprocating parts are counterbalanced there will be an excessive longitudinal disturbance of the engine. The counterbalance should be a medium between these two extremes, and the only question is: What portion of the reciprocating parts is to be left unbalanced?

W. T. Gale, Vice-Pres., General Foremen's Association

A great many experiments and theoretical calculations have been made to find an answer to this question. Dr. W. F. M. Goss, one of the early investigators of the action of overbalance on the rail, presented a paper before the meeting of the American Society of Mechanical Engineers in New York, December, 1896, in which experiments in the Purdue Locomotive Testing Laboratory were summarized. The rear driver of the locomotive (a 4-4-0 type) was overbalanced about 50 per cent according to various rules. At speeds in the neighborhood of 60 m.p.h. the greatest pressure of the wheel on the rail was 28,000 lb., or twice the static pressure. It was also shown that the contact of wheel and rail is not continuous, but a succession of impacts. This was shown to be true even when wheel pressure is heavy.

C. L. Dickert, Vice-Pres., General Foremen's Association

The rule adopted by the American Railway Master Mechanics' Association is to balance the weight of all the reciprocating parts on one side of the engine minus 1/400 part of the weight of the engine. This rule is generally used throughout the United States. It is modified, however, in some instances by limiting the counterweights to from 55 per cent as a minimum to 65 per cent as a maximum of the weights of the reciprocating parts, for road engines, this weight being divided equally among all the driving wheels. This is not universal practice. If the wheel centers are too small to put all the counterbalance apportioned to the main drivers on the side opposite the crank pin, and get it within a reasonable area that does not exceed the area of half of the semi-circle, the excessive weight should be distributed equally among the remaining wheels on the same side of the engine.

On the Chicago & North Western the practice is to make the final adjustment of weight in the counterbalance after the axle and crank pins have been pressed in. The wheels, with crank pins, nuts and washers in place, are so arranged that the journals can roll on level straight edges. On main wheels of outside hung valve gear engines both eccentric cranks must be in place. On the side opposite to the one being weighed a weight equal to the weight of the back end of the eccentric rod must be hung on the eccentric crank pin; the crank pin on the opposite side from the one being weighted should be above and in a vertical line drawn through the center of the axle. Weights are hung on the crank pin until the wheels are balanced, and will remain in any position. The sum of these weights should equal the required unbalanced weight, which is composed of that portion of the main rod and side rod plus the reciprocating weight, which belongs to the wheels being balanced. If the sum of the weights does not equal the required unbalanced weight at the crank pin, then additional weight must be added to, or, as the case might be, weight should be removed from the counterbalance until the wheel does balance.

W. F. Hall, Sec.-Treas., General Foremen's Association

All the revolving weights belonging to each wheel and all the reciprocating weights on one side, less the total weight of engine divided by 400, are balanced. This weight is to be equally divided between all the wheels on one side. The revolving weights are the crank pins complete with nuts and collars, the back end of the main rod complete, and that portion of the complete side rod which belongs to each wheel. On the outside hung valve gear engines, in addition to the above, the eccentric crank complete, and the back end of the eccentric rod complete, are included. The reciprocating weights are the piston and rod, crosshead and pins, crosshead arm, the lower end of the combination lever arm, the combination lever link, and the front end of the main rod, all parts complete. The side rods and main rods should be weighed complete with each bearing separately supported on round bars passing through the center of the bearing.

The practice of the New York Central corresponds to the rule adopted by the American Railway Master Mechanics' Association, except that the weight of the reciprocating parts minus 1/400 weight of engine is changed when necessary to come inside the following limits: For wheel centers under 58 in. in diameter the minimum is 55 per cent, and the maximum is 66 per cent of the total reciprocating parts. For wheel centers over 58 in. in diameter the minimum is 60 per cent, and the maximum is 66 per cent of this weight. The reciprocating parts taken into consideration are: the piston complete, the piston rod, the crosshead complete, the crosshead arm and the combination link on Walschaert

valve gear engines and the front end of the main rod complete. The main and side rods are all weighed on knife edge supports. The allowance for the weight of the eccentric crank is 40 lb. for cranks the weight of which is less than 50 lb. and 80 lb. for cranks the weight of which is 50 lb. or more.

The final adjustment of the counterbalance is made as shown in Fig. 1. The axle supports are 1½ in. by 10 in. by 50 in. steel plates mounted with horizontal adjustment on cast iron horses. The weight support is of wrought iron hung from a yoke to fit over the crank pin, the bearing being on two 3-in. rollers set 4 in. between centers. The axle supports are leveled with a spirit level. The counterbalance is adjusted to make the opposite pin set exactly over the center of the axle.

A report on "Counterbalancing" presented to the Master Mechanics' convention, June, 1915, advocated a ratio of

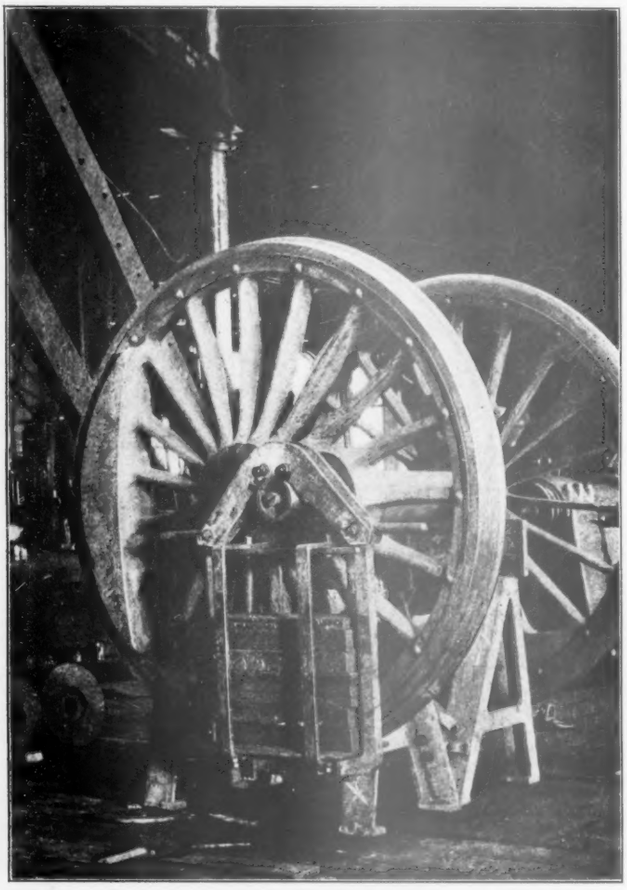


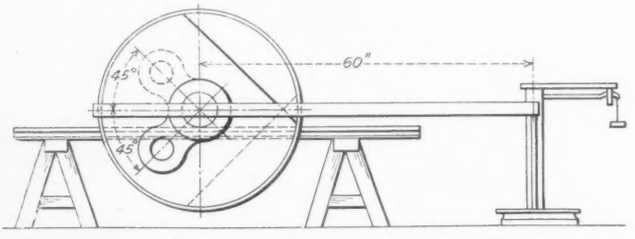
Fig. 1—Adjusting Counterbalance on a Locomotive

the total weight of the reciprocating parts on one side of the engine to total weight of engine. Tests were run on nine engines of the 4-4-2 type, 80-in. drivers, on the Philadelphia & Reading to determine what this ratio should be. At the conclusion of the test the recommendation was made that the reciprocating parts should weigh less than 1/160 part of total weight of the engine, and that 50 per cent should be counterbalanced for engines running at "diameter speed," i. e., a speed in miles per hour equal to diameter of wheels in inches. If normal speed is less than this, the counterbalance percentage may be raised to as high as 65 per cent.

It is very evident that the percentage of the reciprocating parts balanced is simply a compromise to give the best average performance at all speeds within range of the locomotive. But, on the other hand, the amount of counterbalance apportioned to the reciprocating parts should be kept as low as possible in order to minimize the so-called "hammer blow" on the rail, and to make the motion of the engine more steady. The logical solution then is to keep the weight of the reciprocating parts as low as possible, using heat treated steel and hollow members wherever opportunity offers.

DISCUSSION

B. F. Harris, Sou. Pac., stated that the two-thirds rule is used on that system, the over-balance in any wheel being limited to an amount which, when multiplied by 38.4 times the radius in feet of the center of gravity of the counterbalance, will not exceed 75 per cent of the static wheel load. The following method is used in correcting counterbalances: To ascertain the weight in the driving wheels which is unbalanced by the weight of attached parts, take two horses of convenient size and on these place two rails weighing not less than 72 lb. per yd. The upper surfaces of these should be made perfectly smooth and covered with a thin lubricant Place the mounted wheels so that the journals will rest on the rails, which must be parallel and perfectly level both longitudinally and transversely. Draw one line across the face of one of the wheels, through the centers of the axle and crank pin and another line through the center of the axle at right angles to the first one. The second line indicates the position of the pin and counterbalance on the opposite



Method of Weighing Counterbalances on the Southern Pacific

wheel. On a line midway between these two, viz., 45 deg. from each, clamp a 10-ft. wooden straight-edge. Measure off from the center of the wheel on the straight-edge a distance of 60 in. and, with the straight-edge level, place a vertical support at this point with its lower end resting on a platform scale. This will weigh both counterbalances at the same time. Ascertain the weight of the vertical support and the end of the straight-edge resting on the scale, the other end being supported at a distance of 60 in. from the scale or at the center of the axle. Subtracting this weight from the former weight, the remainder will be the weight of both counterbalances corrected for a distance of 60 in. from the center. To find the effective counterbalance for one wheel at crank pin distance, multiply this remainder by the length of the lever—that is, 60 in., and by 1.4142 (secant 45 deg.) and divide by twice the crank pin radius in inches. This method is based upon the assumption that the weights in the two wheels are alike, as both are weighed together, and no means is provided for correcting for differences between the two wheels.

Several members objected to the practice of distributing the over-balance for reciprocating parts among the drivers other than the main wheel. This leaves the main wheel light and if the amount of the over-balance thus distributed is large it will cause the rod bushings to pound out and may lead to the fracturing of the rods. The use of counterbalance bobs placed on the main axle inside the frames has effected a reduction in the wear on rod bushings in such cases.

FITTING UP SHOES AND WEDGES

BY W. E. WARNER
Shop Superintendent, New York Central West, Elkhart, Ind.

The importance of having the shoes and wedges properly adjusted on a locomotive frame cannot be overestimated. A set of shoes and wedges improperly adjusted may cause an endless amount of trouble in the operation of the engine, as, for instance, the breaking of side rods and main frames, the cutting of flanges and numerous other defects to the locomotive mechanism. In order to lay out shoes and wedges correctly it is necessary that the frames be correctly laid out and machined. They should be set up in a square and level position properly adjusted, the binders in place and bolted as tightly as possible without setting up any unnecessary strain. The pedestal jaws should be chipped and filed to a

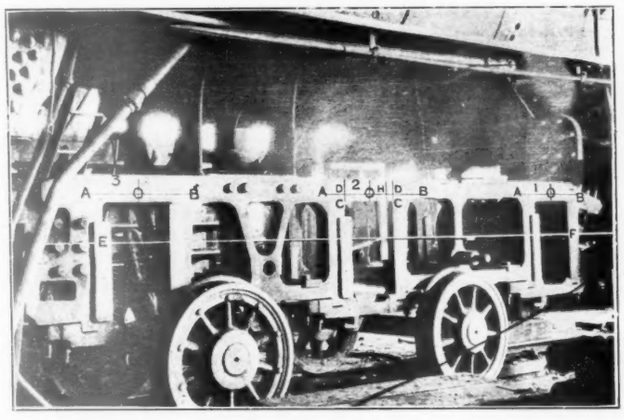


Fig. 1

plane surface, because the shoes and wedges must have a solid bearing against the jaws. Otherwise there is liability that they will be broken when too great a force is applied to them.

A method of laying out the shoes and wedges that has given entire satisfaction in every particular in many large shops is explained herewith. In this description the subscript numbers refer to the various jaws, the forward jaw being numbered 1. The "primes" indicate that the point in question is located on the inside of the frame. To locate the center of the axles on the frame refer to Fig. 1. Lay-off the line *AB*, parallel to the top of the frame, with hermaphrodite calipers at any convenient distance below the top of the frame. With one leg of a square on top of the frame draw the vertical lines *DC* from the front and back faces of the main jaw (jaw 2 in this case) intersecting the line *AB*. Bisect the line *DD* to obtain the center of this jaw at *O*. Locate the centers O_1 and O_3 of the other jaws by means of standard solid trams of the correct length.

To locate the centers of the jaws on the other side of the engine square with those centers which have just been determined, run lines *EF* through both cylinders and parallel to the frames. Place a straight edge through the main jaws, just below this line, and square it to the lines on both sides. With parallel blocks on top of the frames square up from the straight edge and intersect the line *AB* at *H* on both sides of the engine. The position of the square is indistinctly shown in Fig. 1. Locate the center of the main jaw on the other side of the engine by transferring the distance *HO* from the first side trammed. The centers of the other jaws are located as described above.

The centers of the jaws having been located the next problem is to lay-off the size of the boxes. Referring to Fig. 2—lay-off *JK*, equal to the size of the box to be used, on each jaw such that the point *O* is equidistant from *J* and *K*. With the dividers set for ½ in. lay-off the points *L* and *M* from *J* and *K*, respectively. The shoes and wedges should then be put in place and the number of liners determined for each by squaring down from the points *J* and *K* on the frame, at least 1/16 in. being left for machining. After the shoes and wedges are properly lined they are clamped firmly in place by means of spreader jacks, the wedges being raised ½ in. from the binder. From the points *L* and *M* on the frame lay-off arcs at *T* and *R* on the shoes and wedges such that *LT* will equal *MR*, this length being such that *T* and *R* will be well on to the shoe and wedge. Lay-off arcs at *U* and *S* such that $TU = RS$.

Referring to Fig. 3—From the point *M* on the line *AB* erect a perpendicular *PQ* by the following method: Lay-off *MN* on *AB* equal to *MO;* with *O* and *N* as centers draw arcs of equal radii on the shoe intersecting at *P* and *Q*. A line drawn through the intersection of these arcs will be perpendicular to *AB*. Then locate the points *R* and *S* on this line, these points to serve as gaging points. Locate *S'* on the inside of the shoe from a straight edge extending between the frames, as shown in Fig. 3, and set square to the frames by squaring both ends of the straight edge from the line *PQ* on both sides of the engine. Then set an adjustable tram to the distance $M_2 M_3$ (Fig. 2), and with *R*, *S* and *S'* as centers locate *R*, *S* and *S'*. In the same manner locate R_3, S_3 and S'_3. To locate the gage points on the wedge set a small scale tram to the box size plus one inch, checking this distance with the points *LM* on the line *AB*, and with *R*, *S* and *S'* as centers locate the gaging points *T*, *U* and *U'* respectively on the wedge. After, by this process, all the gage points on all the shoes and wedges are laid-off, the shoes and wedges are ready for machining. When the engine is wheeled it is well to check the distances between the wheel centers and rod lengths with the standard solid trams.

DISCUSSION

The discussion indicated that the practice of laying out shoes and wedges outlined in the report is generally followed. Exception was taken, however, to the use of lines through the centers of the cylinders as a means of squaring the boxes on

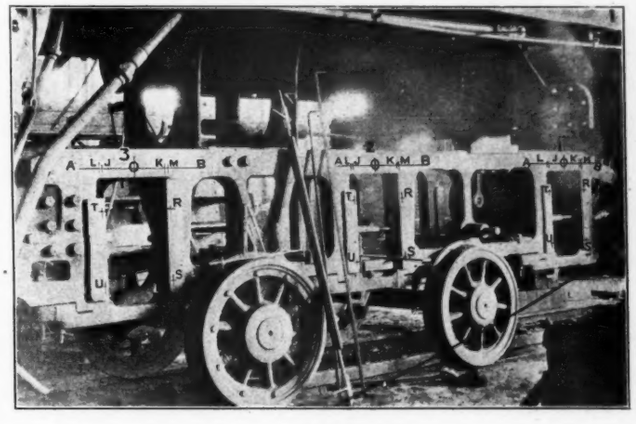


Fig. 2

the two sides of the engine, because of the ease with which these lines may be knocked out of proper adjustment. The use of the fish-tail tram is preferred in some cases, for this reason. Although the proper laying out of shoes and wedges is necessary to prevent cut driving wheel flanges, there are other causes for this trouble. Where it exists and difficulty has been found in locating the cause, it will often be disclosed by calipering the tires. On the El Paso & Southwestern, where considerable trouble has been experienced from cut flanges due to track conditions, a water rail washer is being used with success. Water is piped from the boiler to points in front of the leading truck wheels and back of the

rear drivers, so that it is delivered to the head of the rail. The use of this device has proved more successful than flange oilers in reducing cut flanges and in keeping engines on the track on certain mine branches.

CLASSIFICATION OF LOCOMOTIVE REPAIRS

C. S. Williams, shop superintendent of the Pere Marquette, described their classification as follows:

Repairs are based upon a certain assigned mileage, the number of miles the engine is expected to make being regulated by the class of the locomotive and the service in which it is used. The following table shows the assigned mileage according to the service and class of locomotive:

Class	Service	Assigned mileage	Gets tubes if needed on
4-6-2	Passenger	125,000	100,000
4-4-2	Passenger	90,000	80,000
4-6-2	Freight	75,000	65,000
4-3-0	Passenger	75,000	65,000
0-6-0	Switch	75,000	65,000
2-8-2	Freight	60,000	50,000
2-8-0	Freight	60,000	50,000
2-6-0	Freight	50,000	45,000

The classification of repairs to engines is as follows:

Class A—New boiler and general repairs to machinery and tender.

Class B—New firebox and general repairs to machinery and tender.

Class C—One or more new firebox sheets with renewal of tubes and general repairs to the machinery and tender.

Class D—Renewal or resetting of a majority of tubes and general repairs to the machinery and tender. This class to include cases where boilers or fireboxes are repaired, but no entire new sheets applied.

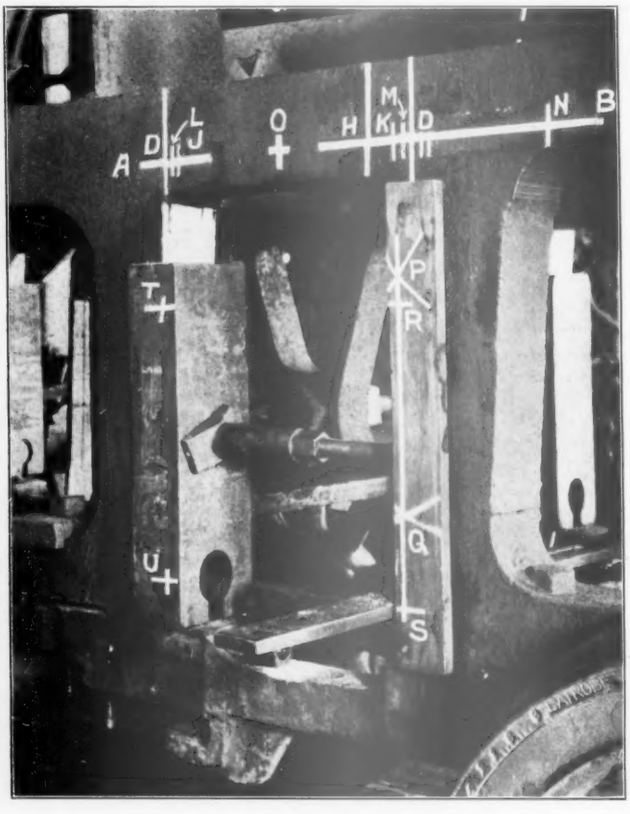


Fig. 3

Class E—Where locomotives have tires turned or partial renewal of tubes or both together with light repairs to machinery and tender.

Class E-F—Repairs to the machinery and tender similar to Class *E* repairs made necessary on account of breakage or failure of some important part of the locomotive not due to accident or collision, where tires may not need turning or tubes require partial renewing.

Class F—Slight repairs to the machinery and tender.

Accident repairs are classified under the letter indicating the approximate cost corresponding with the necessary repairs given the locomotive. The report of such accident repairs shows the classification letter assigned on the above basis with the prefix "Acc."

It is impossible to give the costs of the various repairs as classified above, due to the fact that the classification letter of repairs covers all classes of locomotives receiving that repair; however, the shops are allowed a repair credit if the total cost of such repairs, labor and material inclusive, costs over $25. Any repair work that costs more than $1,000, regardless of class of locomotive or class of repairs, are itemized on a form used for that purpose and authority is obtained to make the repairs, unless the engine to be repaired has made the mileage assigned according to the table shown above.

When an engine is due for the shop the road foreman of engines makes a report showing the repairs needed. This is sent to the shop when the engine is taken out of service and advises the man in charge at the shop just what is to be done when the engine arrives for repairs. When the engine arrives at the shop it is examined and if the assigned mileage has not been made an itemized report of the repairs needed is made up and authority is asked to make the repairs. This statement must also show the cost of the repairs.

The most important item in shopping engines is to mix them up if possible so that the shop will not be filled with all "heavies" at one time and all "lights" the next time so as to maintain a certain output for each month and not have it fluctuate with a large output one month and a small one the next. The repairs are planned a month or so ahead, on engines that are in service and the engines are shopped accordingly. The shop superintendent and general foreman are furnished with a statement each month showing the engines in their district, their mileage and tire wear, and as the repairs are based upon the mileage and tire wear it is very easy to pick out the engines that will be soon due for repairs and plan accordingly, working, of course, in harmony with the man directly in charge of the engines.

The engines are dated out as soon as they are taken in the shop and the length of time given for the repairs is governed by the class of repairs the engine is to receive.

A weekly meeting is held with the shop foremen and sub-foremen and a list is made up showing engines due out for that week. Copies of the list are given to the foremen, sub-foremen and all leading workmen. This list also covers the engines that are expected for the following week. Everyone works to the list and when their work is completed on one engine they move on to the next.

The store department orders the material and makes requisitions according to the consumption of material, always carrying enough staple articles on hand to meet all demands. The material is all machined on shop orders and placed back in the store stock ready for use when needed, which does not cause any delay to repairs.

In contrast to this system may be mentioned the following classification in use on one road where the repairs are based upon cost alone:

"Light Repairs" ..... $250 to $500
"Heavy Repairs" ..... $500 to $1,250
"General Repairs" ..... $1,250 to $1,750
"Rebuilt" ..... $1,750 and over

It will be noted that there is no mileage specified for boiler tubes or general repairs and that the classification does not give any idea of the actual repairs the engines receive. For instance if an engine receives a new set of tires and new tubes the cost would be high and yet the engine would receive minor repairs in connection with the new parts, while on the other hand another engine of the same class may have the tires turned, tubes reset and other heavy repairs without using much material and be a much better engine as far as condition goes and yet not cost nearly as much. The difference in cost may mean a "heavy" for the best repaired engine and a "general" or "rebuilt" for the engine that received a lot of new material and not so much repair.

Another point about this method is that an engine can be taken in the shop two or three times a year and if $250 is spent the work will be credited to the shop. On the other hand, if an engine is in for light repairs, the cost for them being $225, or $25 below the lowest figure in which a repair is allowed, it is not fair to the man in charge of the shop not to be allowed credit for the work and it is not fair to the company when the shop man, knowing that the cost is too low to receive credit for the repairs, transfers the needed $25 from some other engine to get the needed amount of $250.

This method of classifying repairs does not give any one a fair chance and causes quite a loss to a railroad. If an engine receives a repair and has to make a certain number of miles before being repaired again, every one that has anything to do with that engine in the mechanical department does all that is possible to get the mileage, as he does not want to assume the responsibility his neglect of needed running repairs may cause. It also gives the railroad company the information they want regarding the kind of work that is being done and gives them full value for the money they are spending on repairs. In order to obtain the maximum efficiency in locomotive repairs it becomes absolutely necessary to classify repairs.

W. W. Scott, general foreman of the Delaware, Lackawanna & Western, described the classification of repairs used at the Buffalo terminal of that road as follows:

Class No. 1. Rebuilt.
Class No. 2. New firebox and general repairs to machinery.
Class No. 2A. New firebox sheet or sheets and general repairs to machinery.
Class No. 3. General repairs to machinery to cost $500 or over.
Class No. 4. Repairs to machinery to cost $100 to $500.
Class No. 5. Light repairs, labor to cost $50.

It will be noted that full credit is given for all classes of repairs made at shops or enginehouse terminals, the light repair classification is often done at enginehouses without calling upon the back shop for labor assistance and the forces so employed receive credit for output and the work is not chargeable to running repairs.

It has been the practice on other railroads with which I have been connected, to handle light repairs in enginehouses with the regular force where the cost has run up to $350 and no output credit given for the operation. It does not seem fair to charge such an amount to running repairs. The cost of engine-house expense should include only such expense as is necessary to maintain a locomotive in a safe and revenue producing condition ready for service after reasonable detention at the engine-house for repairs, grooming, coal, water and inspection.

In order that the mechanical department may obtain complete information relative to the condition of the power and the amount of service it is possible to obtain from each engine before the shopping period, the master mechanic calls a meeting each month of the general foremen, the general boiler foremen, the boiler inspectors, the division roundhouse foremen, the road foremen of engines, the traveling foremen and the chief clerks, all of whom come prepared with detailed information on each locomotive in general and its appurtenances in particular. A medical doctor is no more critical in his diagnosis of a patient's condition than is the mechanical department in determining the condition of its locomotives. After these reports have been received the locomotives are divided into six classes, as follows:

Class 1 locomotives are serviceable for a period of 9 to 12 months.
Class 2 locomotives are serviceable for a period of 6 to 9 months.
Class 3 locomotives are serviceable for a period of 3 to 6 months.
Class 4 locomotives are serviceable for a period of 1 to 3 months.
Class 5 locomotives are in the shops at Buffalo.
Class 6 locomotives are locomotives belonging to the Buffalo division in the shops at Scranton.

From this engine condition report the proper classification of the repairs is given to each engine before it enters the shops. The department foremen are given a copy of this report so that each one knows what material will be needed when the engine does come into the shop, and the storekeepers are advised as to the material that will be needed. Every mechanical foreman has a convenient and intelligent report of the condition of each locomotive on the division, and there is no occasion to fear the inspection of the Federal and State authorities.

DISCUSSION

From the discussion of this report it appears that there is a wide diversity in the methods of classifying locomotive repairs used on different roads. The methods outlined in the report are those most generally used but on some roads repairs are divided into as high as 12 or 14 different classifications.

L. A. North, Illinois Central, advocates the use of cost of material as a basis of classification, in order to secure comparable results on different railroads. Owing to the wide variation in the cost of labor in different localities the total cost of repairs is not comparable, whereas the cost of material will vary but slightly throughout the country.

M. J. Gunther, El Paso & Southwestern, stated that the mileage of switch engines between shoppings has been greatly increased by the use of recording speed indicators. Before these instruments were used an arbitrary allowance of 72 miles per day was credited to each switch engine. On this basis it was difficult to secure the allotted mileage from the engines between shoppings. On equipping the engines with speed recorders, however, it was found that they were actually making from two to three times the actual miles which were being credited to them.

RELATION OF FOREMEN TO MEN

BY T. E. FREEMAN
General Foreman, Duluth & Iron Range

Leadership is one of the world's most precious possessions. For the common good, leadership should be cherished and encouraged and allowed to reap its full reward. We must continue to keep wide open for every one, for the man of one talent and for the man of many talents, the golden gate of opportunity. Foremen should keep their assistants in touch with all their work and correspondence, so that they will be able to answer any questions which pertain to the shop during the foreman's absence.

A foreman should never be domineering, manifesting a spirit and a disposition that he knows it all. In doing his work, if a man offers a suggestion, listen to him. If it answers the purpose, use it. It will make him feel good, and will draw out the best that is in the man, and will encourage all of the men to think. If his way is not practicable, tell him kindly why it is not and his confidence and respect will still be retained. Some men may take advantage of kindness. This is the exception and not the rule. Do not ill-treat all the men because five or six are ungrateful and do not appreciate the interest taken in their behalf.

There are two very important factors in getting out work: First, the man's ability to do the job. Second, his willingness to do it. To get the best results, the foreman should be in close touch with his men. Study, if possible, the character and disposition of the men. This will help in distributing the work to the best advantage. Nationality, religion, politics, or personal friendship should have no place in the shop. All men should be treated the same. The foreman should be firm, but kind and just, letting his men know what he wants and what is expected of them. Never countenance or encourage talebearing. A foreman's character should be such as will appeal to his men in everything that stands for good, pure and upright manhood. When orders are issued it should be seen that they are obeyed. If at any time it is necessary to correct or call any of the men to account for neglect of duty, do it privately, never publicly

or while angry. Never swear at the men. To punish or make unkind remarks to men in the presence of others, lowers the standing of the foreman in the estimation of the men, and nothing will be accomplished.

Should a Foreman Be a Leader or a Driver?—In answer to the question: "Should a foreman be a 'leader' or a 'driver'?" some may say, it is necessary to be both, for there are men who have to be driven, as mules are driven, in order to get them to work. I do not agree with this assertion, first, because I do not believe it is in harmony with human nature, and second, I do not believe it is true. The very essence of good foremanship—as of good leadership—is co-operation. Men like to work with—not for—a man who shows some regard for them, who is fair with them, who is thoughtful for their welfare. And where men like to work the best results are obtained. The swearing, driving foreman has no place in modern efficiency. The modern methods are to get the best out of workmen by bettering the men themselves.

The foreman who is a leader, who possesses and exercises the essentials of leadership, will have a loyal and, usually, efficient following. His men will be with him rather than under him. They will do their best for him because he does his best for them. They will respect him because he respects them. They will be fair with him because he is fair with them. They will advance him because he advances them. And in thus treating his men he puts himself in the surest way for still wider and more important activities, for a still higher and more responsible trust.

The foreman who is a "driver" must keep on driving to get results. He cannot expect loyalty, for loyalty comes voluntarily; it cannot be compelled. He need not look for co-operation because his methods arouse antagonism. He must remain always back of his men rather than have his men back of him. As a "driver" he is likely to be kept on the lower levels where driving is supposed to be needed. His methods are most likely to stand as an effective bar to his own advancement. The leader is always at the head of his men. The driver, of necessity, must remain in the rear. When opportunity for advancement comes the man in front has the first chance. The same friendly relations should exist between the foreman and his men as betwen the master mechanic and the foreman.

Lack of attention to details by foremen is a contributory cause of mental disturbance in employees, which in turn interferes with their capacity for production. I refer particularly to the failure of foremen to interest themselves in the matter of conveniences for employees in the handling of their work, as well as providing for their bodily comfort. It is a common condition in many shops to find employees trying to make headway with defective tools.

Quality and Shop Output.—Great claim is generally laid on the importance of a large shop output, the common basis of measurement being the number of locomotives a month which can be repaired in a given shop. The ability of a foreman to increase the output of a shop is very commonly used as an indication of his value as a manager. No doubt this is a reasonably good method of arriving at an estimate of a man's ability; but there is a question of the advisability of using this as the only basis for arriving at such an estimate. Quantity is desirable and even essential in shop output. Economy demands that locomotives spend as large a proportion of the time as possible in earning money, which means that they must spend as little time as possible undergoing repairs. But there is more to the repair question than the heavy repairs made in the back shop. Most locomotive repair work is done in engine houses and it is at this point that the effect of laying too much stress on general repair shop output or quantity with a neglect of the quality of the work done makes itself most directly felt.

There are many shops in this country which are rated entirely on the number of locomotives turned out per month in determining the output, when the railway company would be money in pocket if the output were reduced as far as numbers are concerned and steps taken to materially improve the work turned out. If the little things are not done in the general shop they will have to be done in the engine house and they may develop into larger things that will compel the return of the engine to the general repair shop long before it has made its full mileage. This is a matter which demands serious attention from higher railway officers as well as shop superintendents and foremen. The maximum possible output of any shop is desirable provided it can be accomplished by the highest quality of workmanship. Quantity without quality will invariably result in increased maintenance charges and decreased mileage between shoppings; quantity and quality combined will tend toward economy in locomotive maintenance and train movement.

Economy in Labor and Material.—There is wide opportunity for economy in bringing railway men in general and shop employees in particular to realize that time and material which they can save in their personal work can have a direct and considerable bearing on the condition of the company's treasury and consequently on their own prosperity. While means should be taken to instill these ideas into the older employees, the place for the most earnest efforts is in the apprentice school, and in this connection the simpler the explanation can be made the better. In many instances the lesson will be kept in mind and while it seems a hopeless task to bring all employees to a correct understanding of such matters, a continued process of education and enlightenment will result in a surprising increase in the efforts of individual employees toward economy.

DISCUSSION

One of the difficulties which confront many general foremen today is the handling of foreign labor. It has generally been the practice to work the various nationalities in gangs by themselves but this has often led to a shortage of labor owing to the difficulty of keeping sufficient men. If one man became dissatisfied it was not unusual for the whole gang to quit in a body. In shops on two different roads, each confronted with the problem of handling several nationalities, this trouble has been solved by breaking up the solidarity of the gangs and mixing the various nationalities. Some trouble was experienced in putting the change into effect, but after the practice had been established no further difficulty in keeping men was experienced.

OTHER BUSINESS

The following officers were elected to serve for the ensuing year: President, L. A. North, Illinois Central, Chicago; first vice-president, W. T. Gale, Chicago & North Western, Chicago; second vice-president, J. B. Wright, Hocking Valley, Columbus, Ohio; third vice-president, George H. Logan, Chicago & North Western, Clinton, Ia.; fourth vice-president, A. E. Warner, New York Central, Elkhart, Ind.; secretary-treasurer, William Hall, Chicago & North Western, Winona, Minn.; chairman of the executive committee, E. E. Griest, Pennsylvania Lines, Ft. Wayne, Ind.

The by-laws were amended to make the office of secretary-treasurer permanent instead of elective annually.

The following are the topics for consideration at the 1917 convention: (1) Engine Failures, Their Causes and Responsibility, and What Constitutes an Engine Failure; (2) Methods of Meeting the Requirements of Federal Inspection Laws; (3) Alinement of Locomotive Parts to Insure Maximum Service and Minimum Wear, and (4) What Interest Has the Locomotive Foreman in Car Matters?

Proper Treatment of Rubber Gaskets.—When packing a flange or cylinder with a rubber gasket, all oil and grease should be wiped from the surface of the metal.—*Power.*

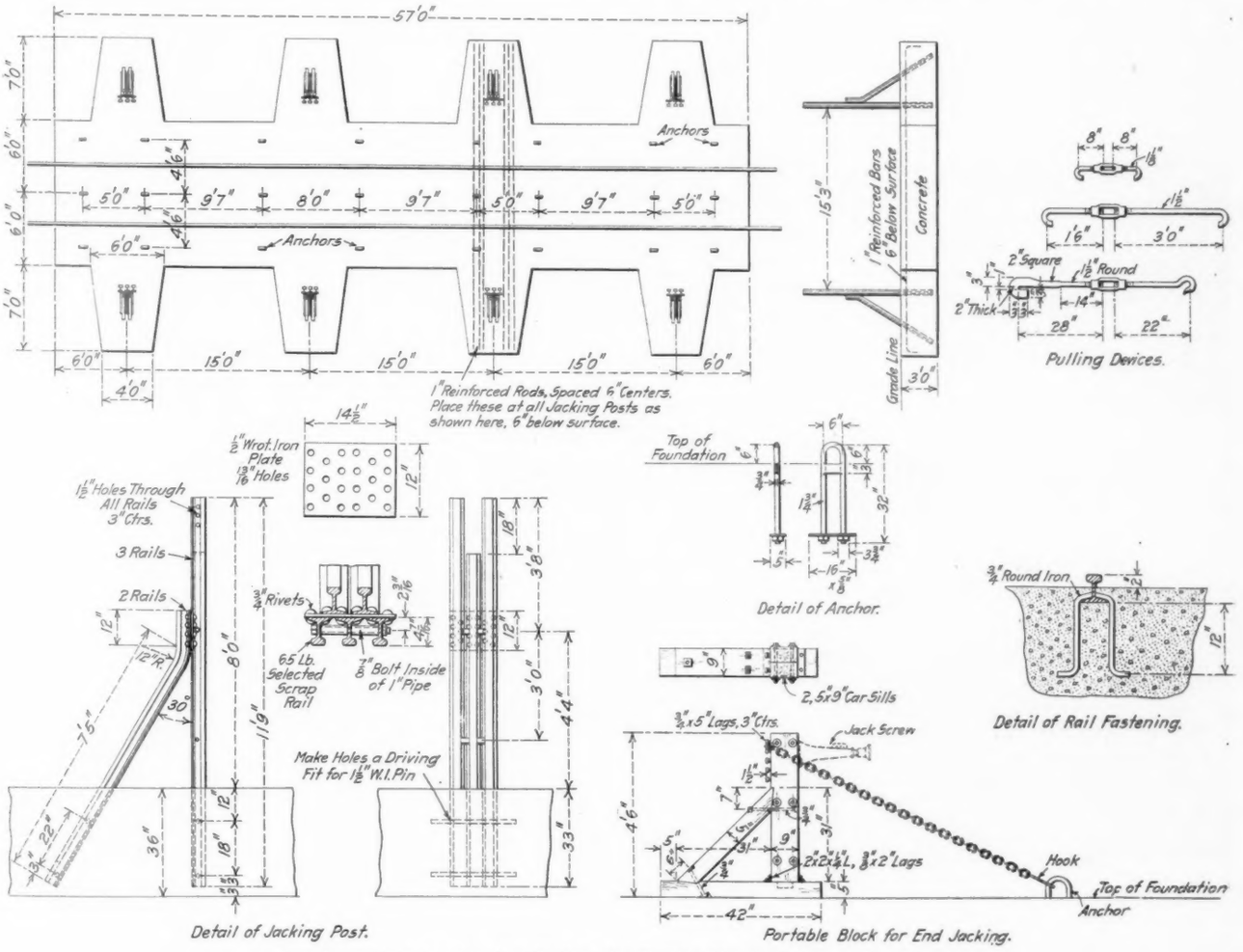
JACKING STALL FOR STEEL CAR REPAIRS

In the report of the convention of American Railway Tool Foremen's Association, which was published in these columns last month, reference was made to the jacking stall for straightening steel underframe cars, which is in use at the Topeka shops of the Atchison, Topeka & Santa Fe, drawings of which were shown before the convention by E. J. McKernan, supervisor of tools. The details of the jacking stall are shown herewith. It consists of a concrete floor 57 ft. long and 3 ft. deep, in which are embedded jacking posts built up of 65-lb. scrap rails and disposed four on either side of the track. Anchors are also embedded in the concrete on either side and in the middle of the track, these serving to secure the portable post used in end jacking and, in some case, the turnbuckle pulling devices.

The stall is housed in a semi-enclosed frame structure 98 ft. long by 48 ft. wide, the roof and sides of which are covered with corrugated iron to a point about 10 ft. from the ground. The center line of the track, which runs lengthwise through the building, is 11 ft. 6 in. from the side, and the concrete stall is placed close to one end.

In the middle of the building, near the end of the stall, is an oil-burning, double end furnace, 3 ft. 11¼ in. wide by 7 ft. 8¼ in. long inside, for the operation of which is provided a 10 hp. motor-driven pressure blower.

This furnace, with conveniently located face plates, provides for the straightening of plates removed from the cars, the stall facilitating the straightening of bent underframes.



Details of Steel Car Jacking Stall at the Topeka Shops of the A., T. & S. F.

CASE HARDENING*

BY P. F. DUGGAN
Foreman Blacksmith, C. & O., Richmond, Va.

Our method of case hardening consists of the use of cast iron boxes of various sizes made to accommodate the number of pieces to be hardened at one time. The smallest one we have is 24 in. by 9 in. by 7 in. deep and will accomodate the motion work of one engine. The largest one measures 64 in. by 15 in. by 9 in., which we use when we have a quantity of miscellaneous material.

In charging one of these boxes we cover the bottom with 1½ in. of the hardening material and then place the pieces in the box about ½ in. apart, being careful to have the thinnest pieces in the middle. We then cover with the case hardening material to the depth of two inches and fill in another layer of the pieces to be hardened, and so on until the box is full. It is then covered with a piece of boiler plate and the edges luted with clay, after which it is placed in the furnace and heated to a bright red. It is maintained in this condition for 5 to 12 hours according to the size of the box and the material it contains. When the box is removed the pieces are taken out one at a time and dipped in clear cold water until they are thoroughly cold. I have followed this practice for more than thirty years and find it very satisfactory.

Of course there have been variations in the material used

*From a paper read before a recent foremen's meeting at the C. & O. shops, Richmond, Va.

for case hardening in that time; for instance, in 1879 we used old leather belting or old shoes—in fact, anything made of leather that was not useful for anything else—bones gathered from around abattoirs and in the fields, horse hoof borings gathered from country smith shops, mixed with some charcoal and three per cent prussiate of potash. For the past two years we have been using a manufactured article which gives the metal a very hard surface, 1-16 in. or 3-32 in. thick in from five to eight hours steady heat according to the size of the box and pieces to be hardened. We can reclaim and use over again about fifty per cent of this compound.

CARING FOR LOCOMOTIVE TOOLS

BY JOHN F. LONG

All tools should be removed from an incoming locomotive as soon as the crew leaves. Pick handles, shovel handles, wrench handles, etc., should be renewed if necessary; oil cans should be cleaned and soldered and new tops applied where necessary; water coolers should be thoroughly cleaned and scalded. All tools should be carefully checked and any shortage reported. Many enginehouses do not have a proper room or building to care for engine tools and supplies. Such a building, however, may be easily provided. In the engraving there is shown a small tool house which was built from scrap car lumber and old galvanized roofing. This building is located near the incoming track. The photographs also give an idea of the interior of the building. At one end a vise has been installed to be used in making repairs to the various tools when required. A place is also provided for records. A wash basin is provided and special attention has been given to heating and lighting.

A side view of the interior shows the scoop arrangement. Note the rack for ash hoes and clinker hooks. Another of the views shows the arrangement made to take care of the various oil cans, torches, buckets, etc. While the building shown is not of the most modern type, it is used for the purpose of illustrating what can be done with the materials in the hands of almost any terminal foreman.

A system of careful checking of supplies issued to engines, and a careful investigation of cases where supplies are lost, will cut down the cost of engine tools surprisingly.

A Homemade Building for Locomotive Tools and Supplies

DOES IT PAY?

BY A. E. M.

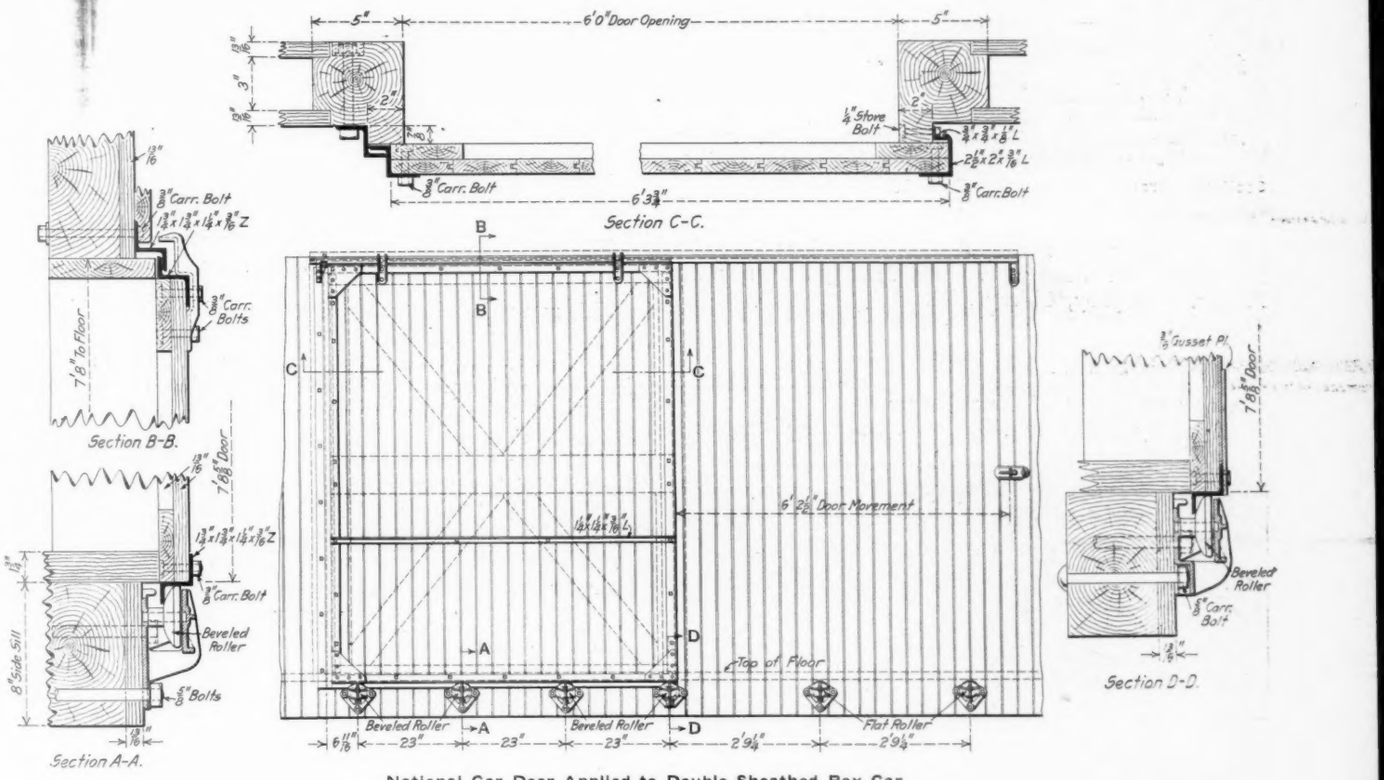
Some years ago the writer was asked by a prominent superintendent of motive power to make a trip over his road and determine the reason why so much metallic packing was used on the locomotives. The conditions found were, to say the least, not what they should be. In fact they were so bad that the superintendent was on the point of asking for a large appropriation to enable him to change over to a different type of metallic packing, hoping thereby to improve these conditions. Many roads have done this very thing and are still doing it, but do they get the proper results? They undoubtedly do for a little while, but they are soon back to where they started, and the reason for this is very plain. Why not have specialists on packing at each roundhouse; give them every assistance necessary to keep the packing in good condition, keep the guides in line, the piston rods round and true, and the piston heads and cylinder packing in good shape. This was done by the superintendent of motive power above mentioned, and although it costs him something to keep the equipment up he found it unnecessary to ask for the large appropriation to make the change to a new type of packing, and what he has saved has bought all his packing for a long while. Think it over! It pays!

Prevention of Scaling in Boilers.—The formation of scale in a boiler may be prevented, it is stated, by applying a coat of aluminum paint to its inside surface.—*Journal of the American Society of Mechanical Engineers.*

New Devices

NATIONAL CAR DOOR

The National door is a car door without a track. It is supported by strong brackets secured to the side sill, its weight and all stresses produced by it being transmitted direct to the underframe. No load is imposed on the superstructure or roof structure and the danger of binding, as in the case of a door hung on a track at or near the eaves of the roof, is obviated. The brackets, usually four at the door opening and two at the back of the door opening, are fitted with rollers 3½ in. in diameter, the door traveling freely on these rollers. To insure a close fit when the door is closed the rollers at the door opening have a beveled face so that boards can be applied at any time. The corner gussets prevent the frame strips from loosening or turning out in case the wood deteriorates. The door posts in the case of double sheathed cars project about an inch outside of the sheathing and the flooring at the doorway is carried out flush with the face of the post, the door being made wide enough to lap over the back post. The top and front frame strips are made of Z-bars, having one leg bolted to the door and the other leg extending out from the door and interlocking with Z-bars or other suitable members on the car. The bottom frame strip is also of Z-bar section, one leg being bolted to the door and the other extending down and behind the rollers described above. The back frame strip is an angle with



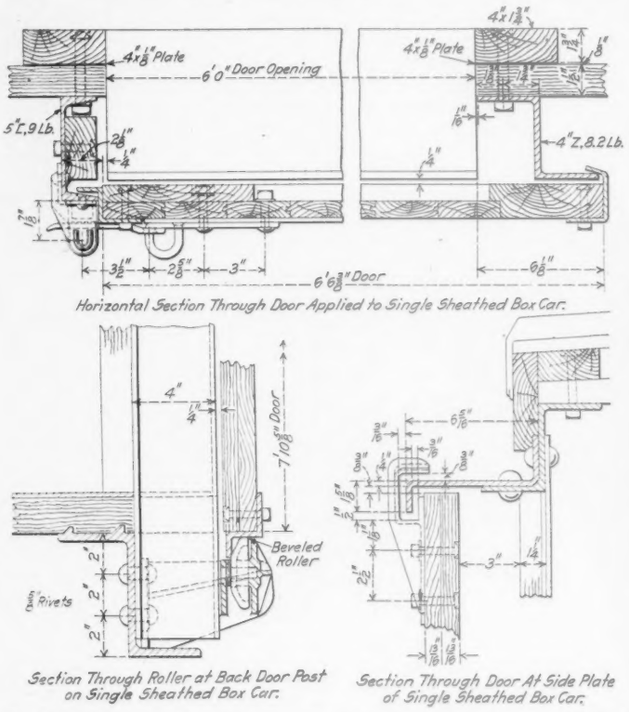
National Car Door Applied to Double Sheathed Box Car

the door is moved inwardly as they rotate. The rollers back of the door opening are flat faced, being inserted in brackets with guide lugs to prevent the door marring the sheathing, but still allowing ample freedom of movement. On steel frame single sheathed box cars the roller brackets are secured with rivets and on double sheathed box cars the roller bracket at the back of the door is so arranged that one of the bolts is concealed, thereby making it inaccessible and thus preventing burglarizing.

The door has a steel frame with gusset plates at the corners and a steel brace extending from the front strip to the back strip. This provides a rigid construction which will keep in alinement and protect the wood, and to which new one leg bolted to the door and the other, slightly longer than the thickness of the door, bent inward to close over the leg of a small angle secured to the back door post. This construction makes the door weather proof and spark proof. The interlocking of the door at all sides also prevents it from being sprung open and the car entered by thieves when once it is closed.

Safety hangers are provided to carry the door on the door hood in the event the car to which it is applied is side-wiped and the bottom roller brackets knocked off. In such a case the door would still be operative. Safety door stops are also provided in case the ordinary back stop is knocked off. These are extra precautions taken to prevent the loss of the

door from the car. From reports of 1,000 cars, on which these doors have been in service for one year, the maintenance expense has been practically negligible and not a door has

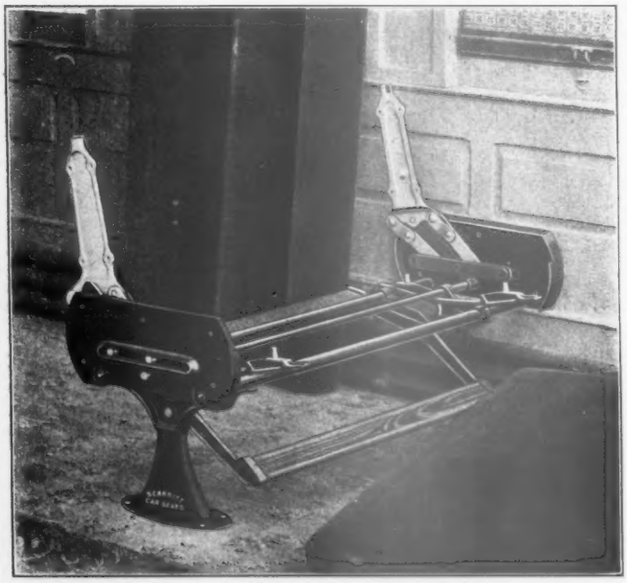

4"x1⅜" Plate
6'0" Door Opening
5"I, 9 Lb.
4"I, 8.2 Lb.
6'6⅜" Door
Horizontal Section Through Door Applied to Single Sheathed Box Car.
7'10⅝" Door
Beveled Roller
Section Through Roller at Back Door Post on Single Sheathed Box Car.
Section Through Door At Side Plate of Single Sheathed Box Car.

Sections Through National Car Door Applied to a Single Sheathed Box Car

been reported lost from a car. The illustrations show clearly the construction of this door. It is made by the Union Metal Products Company, Chicago, Ill.

SIMPLEX COACH SEAT

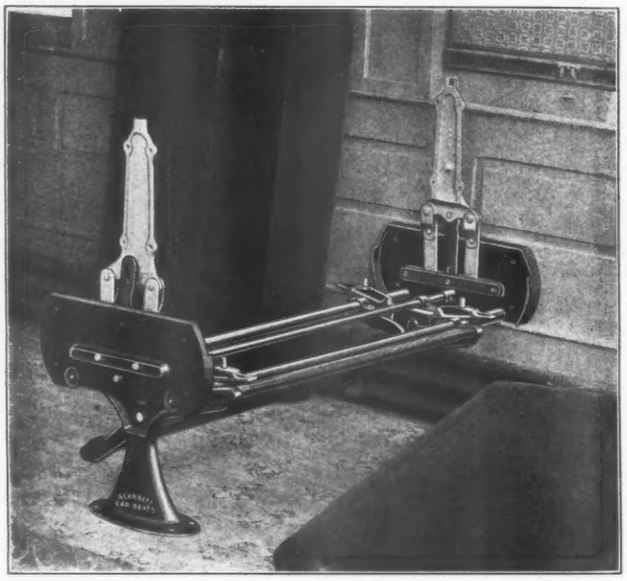
A new coach seat of the pull-over type has recently been developed by the Scarritt-Comstock Furniture Corporation,



Normal Position of Simplex Coach Seat Reversing Mechanism

St. Louis, Mo., the reversing mechanism of which is claimed to be exceptionally easy and smooth in its operation.

The general features of the construction and the operation of this seat may be seen from an inspection of the accompanying illustrations. The back is supported by two short reversing levers, the lower ends of which slide in a slot in the end frames. The center righting levers are the active agents in reversing the seat, the lower ends being keyed to a shaft which reverses the cushion frame by means of arms also keyed to the shaft. The upper ends are attached to the back support through a longitudinal slot. Near the lower ends of each of these levers is a longitudinal slot by which it is attached to the moving base or fulcrum of the reversing levers.



The Reversing Mechanism in Mid-Position

This moves in a horizontal direction only, being guided by a slot in the seat end frames.

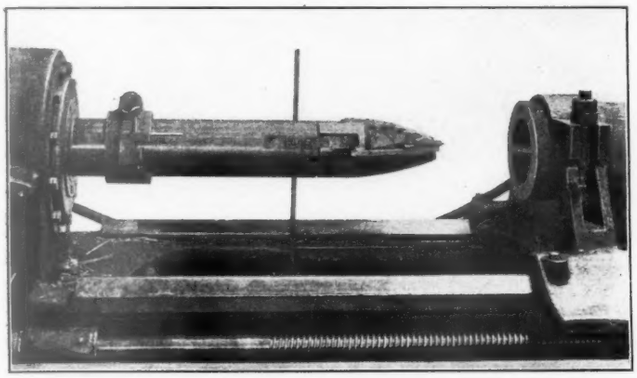
The wall and aisle frames are connected by two steel tubes through which pass steel rods. The pedestal is attached to the steel tubes and is adjustable so that it may be bolted securely to a member of the underframe supporting the floor of the car. The foot rest is hung on corrugated friction joints and is not automatic, thus relieving the seat reversing mechanism of its operation. The back cushion is very easily removable, no difficulty being encountered in removing and replacing both the seats and the back cushions in an entire car for the purpose of cleaning.

BALL BEARINGS IN LATHE CONSTRUCTION

A lathe has recently been developed by the Hart-Parr Company, Charles City, Iowa, the spindle of which has been mounted in Gurney ball bearings. These lathes were designed especially for use in the manufacture of shells from 6 in. to 12 in. in diameter and have been heavily built throughout to withstand the continuous heavy service during a 24-hour working day.

From the illustration it will be seen that the headstock and bed are cast integral, the front and rear headstock bearings being connected by side walls. The spindle is 6⅝ in. in diameter and for all ordinary shell work it is depended upon to provide a sufficiently rigid support for the boring tools and formers, the same being true when the spindle is used as an expanding arbor to carry the shell while performing the outside turning operations. It will thus be seen that the requirements of the headstock bearings are especially severe, as in all ordinary work no outboard bearing for the end of the spindle or the work is provided.

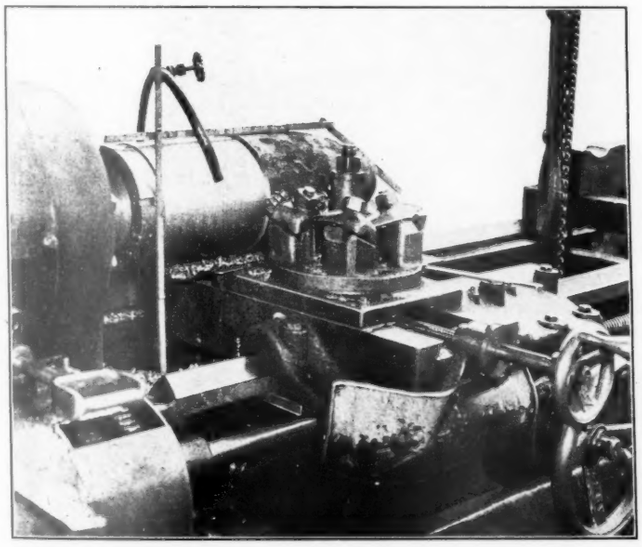
The spindle is mounted in combination radial and thrust bearings, the front bearing being 6.69 in. in diameter and the rear bearing 4.33 in. in diameter. These bearings are of the radial type, the raceways encircling the balls on the thrust side far enough to prevent any wedging action and to provide a reaction at the proper angle to take care of both the thrust and radial loads. These bearings are very accurately fitted and when properly opposed in order to prevent any tendency toward longitudinal motion of the spindle,



Boring Head for Finishing Interior of Shells. Overhang is 36 in.; Distance Between Bearings 33 in.

provide an accuracy of alinement of the spindle, which will be maintained permanently, subject to practically no wear, whereas the maintenance of alinement with the ordinary spindle bearings is somewhat difficult owing to the effect of wear. One of the photographs shows clearly the extent of overhang of the cutting tool which the spindle must support. The tool is for machining the arch on the interior of the nose of the shell, which is secured to the carriage of the machine and fed onto the tool.

The spindle of the lathe is worm driven, the worm wheel



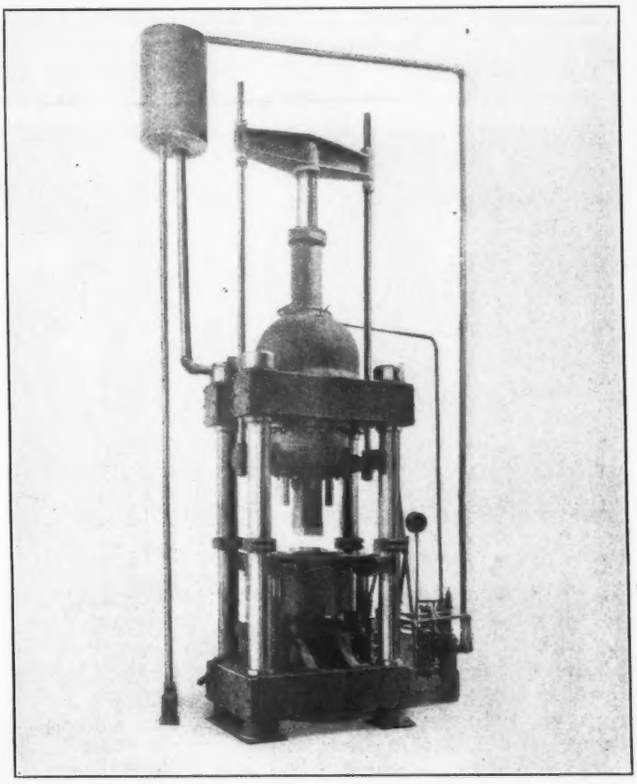
Shell Mounted on the Mandrel for Finishing the Outside

being mounted on the spindle and driven from the underside by a worm mounted on the cone shaft, which is located in front of the machine. This arrangement provides for high speed operation of the belt cone, enabling a 3-in. belt to provide ample power for the machine, the drive being especially steady in its action and entirely free from chatter.

This is one of the first successful applications of ball bearings to a lathe spindle, difficulty usually having been encountered from a tendency of the ball bearings to produce a slightly wavy surface on the finished work. The bearings are manufactured by the Gurney Ball Bearing Company, Jamestown, N. Y.

HYDRAULIC BRIQUETTING PRESS FOR METAL BORINGS

The accompanying photograph illustrates a new design of hydraulic press recently brought out by The Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, for use in briquetting metal borings, turnings, etc., so that they may be remelted without the loss of valuable ingredients and to prevent oxidation. It also puts the material in a convenient form for handling. The press is of the four-rod inverted cylinder type and is built in three different sizes and



Metal Briquetting Press

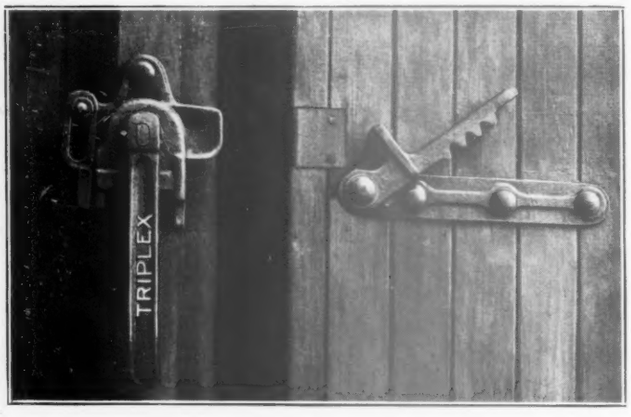
pressure capacities, viz., 1,000 tons, 750 tons and 300 tons. The illustration shows the 1,000-ton press.

The briquet forming mechanism of these presses has been patented in the United States and Canada, as well as in several foreign countries. It is capable of forming a briquet quickly and of uniform density. This is accomplished by placing the material in a floating mold which is supported by four springs; when the pressure is applied upon the material from above the friction of the material on the sides of the mold causes it to move down over a stationary plunger which projects into the mold from below. Pressure is thus applied on the bottom as well as on the top of the material and its density is made uniform. After being formed, the briquet is ejected from the mold by applying the pressure of the main ram upon the briquet, the lower plunger being removed by the movement of a controlling lever. The large press is provided with a surge tank, the base of which is located higher than the main cylinder. By a simple movement of the valve lever the plunger drops to the material in the mold and the main cylinder is filled with fluid by suction of the ram as well as by the weight of the fluid. The first stroke of the pump then starts the pressure upon the

material. The main ram is returned by means of the auxiliary ram located at the extreme top of the press, this action returning the fluid to the surge tank. The presses are solidly built throughout. The strain rods are made of heat treated forged steel and have solid heads and collars. The main ram is guided by babbitted bearings working upon the strain rods and by a long bearing in the throat of the cylinder and the floating mold is also guided by babbitted bearings.

BOX CAR DOOR LOCK

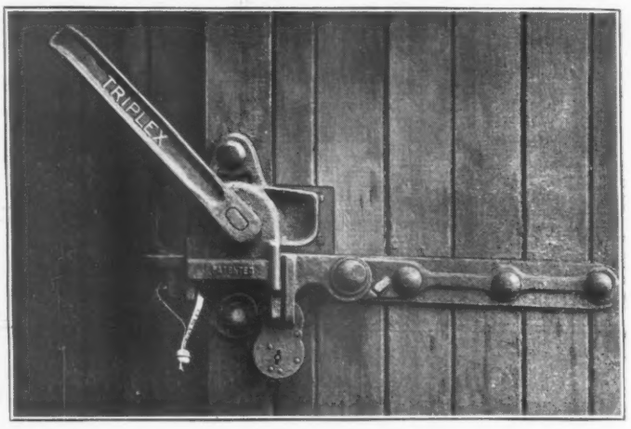
The Triplex Lock Company, Michigan City, Ind., has placed on the market a new box car door lock, which provides a means for locking the door with a padlock in addition to the regular seal method. The lock is so constructed that additional power is obtained in closing and opening the door through a segmental gear and rack, as indicated in the illustrations. As the door approaches the closed position the rack, which is attached to the door, is thrown over and passes through a slot in the gear housing on the door post.



Triplex Lock with the Car Door Open

This rack meshes with the gear, which in turn is operated by the handle shown. By twisting the handle the door is drawn to its shut position, a multiplication of power of 9 to 1 being obtained. A slotted lug on the rack abuts a corresponding lug on the gear housing through which the padlock is passed. The seal pin passes through a hole in the end of the rack and the seal is passed through the pin and a lug on the gear housing, as shown in the second illustration.

In opening the door this same increased power is available and eliminates the necessity of using crow bars and sledge hammers, which so often injure the car doors. The rack attachment also has the added advantage in that in case of a sagging door sufficient power may be exerted to bring the door up tight against the stop, permitting it to be locked, as above described. It will also be noted that a bracket on the



Triplex Lock with the Door Shut and Locked

gear housing forces the door up tight against the door post as the door is drawn to the closed position; this permits the lock to operate freely, the door thus being securely fastened.

URANIUM IN HIGH SPEED STEEL

One of the recent developments in high speed steel is the use of Uranium, which possesses marked deoxidizing and denitrogenizing effects when applied to steel. A number of tests have recently been made under the direction of the Standard Chemical Company at several shops in the Pittsburgh district, in which the performance of Uranium steel has been compared with that of other high speed steels. The results of these tests are given in the table below.

The tools marked *A, B, C* and *D* were of high speed steel and those marked *U* were of Uranium steel.

The effect of Uranium in tool steel is to increase the toughness and largely eliminate brittleness. The heat treatment of the Uranium alloys presents no new features, as they are handled in the same manner as other high speed steels, being heated to between 2,200 deg. F., and 2,300 deg. F. and then, when drawn back, to 900 deg. F. Air quenching is preferable although oil may be used.

The production of Uranium high speed steel is now being taken up by several tool steel manufacturers. Both ferrous and non-ferrous alloys of Uranium are supplied by the Standard Alloys Company, Pittsburgh, Pa.

Tool.	Material.	Feed.	Speed.	Depth of cut.	Remarks.
U—a	Locomotive axle	3/32 in.	103 f.p.m.	3/8 in.	Ran 5 in.
A	Locomotive axle	3/32 in.	103 f.p.m.	3/8 in.	Ran 2 in.
U—a	Locomotive crank pin	1/16 in.	74 f.p.m.	5/8 in.	Ran 12 in.
A	Locomotive crank pin	1/16 in.	74 f.p.m.	5/8 in.	Ran 2 in.
U—a	Locomotive crank pin	1/16 in.	64 f.p.m.	5/8 in.	Ran 8 in.
A	Locomotive crank pin	1/16 in.	64 f.p.m.	5/8 in.	Ran 2 in.
U—1	12-in. shaft .50 per cent carbon	1/16 in.	75 f.p.m.	1/4 in.	Went over once, distance of 14 in. On second lap went 3 in.
B	12-in. shaft .50 per cent carbon	1/16 in.	75 f.p.m.	1/4 in.	Went distance of 4 in.
D	12-in. shaft .50 per cent carbon	1/16 in.	75 f.p.m.	1/4 in.	Went distance of 1 in.
U—1	8-in. shaft 7 ft. 5 in. long	1/16 in.	51 f.p.m.	5/8 in.	Went over twice. Cut changed to 3/4 in. on second turn.
C	8-in. shaft 7 ft. 5 in. long	1/16 in.	35 f.p.m.	5/8 in.	Did not go 1 in.
U—1	6-in. shaft	1/32 in.	75 f.p.m.	5/8 in.	Ran 18 in.
U—2	6-in. shaft	1/32 in.	75 f.p.m.	5/8 in.	Ran 13 in. Speed increased to 90 f.p.m. and ran 11 in. Tool still good.
B	6-in. shaft	1/32 in.	75 f.p.m.	5/8 in.	Ran 11 in.
U—4	10-in. shaft	1/16 in.	60 to 65 f.p.m.	5/8 in.	Ran 8 in.
U—2	10-in. shaft	1/16 in.	65 f.p.m.	5/8 in.	Ran 4 in. Speed increased to 80 f.p.m. and ran 3 1/2 in.
U—1	12-in. shaft, 22 in. long	3/64 in.	55 f.p.m.	5/16 in.	Ran 16 in.
U—5	12-in. shaft, 22 in. long	3/64 in.	55 f.p.m.	5/16 in.	Ran 15 in.
B	12-in. shaft, 22 in. long	3/64 in.	55 f.p.m.	5/16 in.	Ran 2 1/2 in.
U—8	12-in. forgings	1/16 in.	45 f.p.m.	5/8 in. to 3/4 in.	Ran 87 in. Most of time the nose of tool was directly on scale.
U—8	12-in. forgings	1/16 in. to 1/10 in.	38 f.p.m.	15/16 in.	Ran 127 in. Time 3 hrs. Speed increased to 65 f.p.m. after 105 in.
U—8	12-in. forgings	1/16 in.	60 f.p.m.	1 1/16 in.	Ran 12 in.

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The Chicago, Milwaukee & St. Paul announces a wage increase of 2½ cents an hour for the 200 or more boilermakers and helpers employed between Mobridge, S. D., and the Pacific Coast. In future the average wage of the boiler makers on this system will be 49 cents and helpers 25 cents an hour. Nine hours will constitute a day's work.

CARS AND LOCOMOTIVES ORDERED IN SEPTEMBER

September car and locomotive orders showed a decided increase over those for August. The totals were as follows:

	Locomotives	Freight Cars	Passenger Cars
Domestic	253	8,852	122
Foreign	6	4,000	...
Totals	259	12,852	122

The foreign orders were comprised of the following: United Railroads of Yucatan, 2 ten-wheel locomotives, Baldwin Locomotive Works; Laurence Marques, for Portuguese East Africa, 3 Santa Fe type locomotives, Baldwin Locomotive Works, and the Guanica Centrale Railway (Porto Rico), one six-wheel switching locomotive, American Locomotive Company. The largest domestic locomotive order was for 230 locomotives, placed by the New York Central and divided equally between the American Locomotive Company and the Lima Locomotive Corporation.

The largest freight car order was placed by the Russian Government with the Bettendorf Company. Other large freight car orders included the following: New York Central, 1,000 gondola cars, Standard Steel Car Company; 1,000 box cars, American Car & Foundry Company, and 1,000 cars, Pressed Steel Car Company; Chicago, Milwaukee & St. Paul, 1,000 cars in company shops, and the Western Pacific, 1,000 cars, Mount Vernon Car Manufacturing Company.

The largest passenger car order was given by the New

York, New Haven & Hartford to the Osgood-Bradley Car Company, authorizing that company to proceed with the construction of 40 baggage cars.

MEETINGS AND CONVENTIONS

Traveling Engineers' Association.—The twenty-fourth annual convention of the Traveling Engineers' Association will be held at the Hotel Sherman, Chicago, October 24 to October 27, 1916, inclusive. The convention was to have been held on September 5, but was postponed on account of the threatened strike of the train-service brotherhoods. The program announced in these columns in August, and other arrangements made for the earlier date, will be adhered to in connection with the new date.

A. S. M. E. Railroad Meeting.—The Railroad Committee of the American Society of Mechanical Engineers has arranged a most attractive program for the meeting of the Railroad Section, which will be held during the annual meeting of the society at New York early in December. It is planned to hold the Railroad Section meeting on Friday morning, December 8, with an afternoon session if it should prove necessary. The program will include papers on Mechanical Design of Electric Locomotives, by A. F. Batchelder, Railway Department, General Electric Company; Clasp Brakes, by Thomas L. Burton, of the American Brake Company, St. Louis; and Pulverized Fuel for Locomotives, by J. E. Muhlfeld, president of the Locomotive Pulverized Fuel Company.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—Owen D. Kinsey, Illinois, Central, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Sation, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel La Salle, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, Albany, N. Y. Convention, October 3-5, Indianapolis, Ind.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C., H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 547 W. Jackson Blvd., Chicago. Convention, May, 1917, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. N. Frankenberger, 623 Brisbane Building, Buffalo, N. Y. Meetings, third Wednesday in month, New York Telephone Bldg., Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Convention, October 24-27, 1916, Hotel Sherman, Chicago.

PERSONAL

GENERAL

A. R. AYERS, principal assistant engineer, equipment department of the New York Central Lines east of Buffalo, with office at New York, has been appointed superintendent of motive power of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio. Mr. Ayers was born on October 26, 1878, at Toledo, Ohio, and graduated from Cornell University in 1900 as a mechanical engineer. He began railway work with the Lake Shore & Michigan Southern as a special apprentice in the same year. He was special inspector from 1903 to 1905, and in the latter year was made night engine house foreman at Elkhart, Ind. The next year he was made assistant general foreman of the Collinwood shops, and in 1907 was promoted to superintendent of shops at Elkhart. From January 1, 1908, to November 1 of the same year he was assistant superintendent of shops at Collinwood, and on the latter date was appointed assistant master mechanic, with office at Elkhart on the same road. He was appointed mechanical engineer of the Lake Shore, the Chicago, Indiana & Southern and the Indiana Harbor Belt, with office at Cleveland in 1910, and in March, 1912, was appointed general mechanical engineer of all the New York Central Lines west of Buffalo, with office at Chicago. In February, 1915, he was appointed principal assistant engineer, equipment department of the New York Central, lines east of Buffalo, with office at New York, and on October 1 left that road to become superintendent of motive power of the New York, Chicago & St. Louis.

A. R. Ayers

R. E. JACKSON, master mechanic of the Virginian Railway at Victoria, Va., has been appointed superintendent of motive power with headquarters at Princeton, W. Va., succeeding F. T. Slayton, who has been assigned to other duties.

H. A. MACBETH, superintendent motive power of the New York, Chicago & St. Louis, has been appointed assistant superintendent motive power at Cleveland, Ohio.

W. H. MALONE, assistant superintendent of locomotive performance, of the St. Louis-San Francisco, has been appointed superintendent of locomotive performance with headquarters at Springfield, Mo., succeeding P. O. Wood.

R. A. PYNE has been appointed superintendent of motive

RAILROAD CLUB MEETINGS

Club.	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Oct. 10	Railway Publicity	Walter S. Thompson	James Powell	St. Lambert, Que.
Central	.....	Train Rules and Disp.; Annual Outing...	John F. Mackie...	Harry D. Vought..	95 Liberty St., New York.
Cincinnati	Nov. 14	Annual Meeting; Banquet.....	.....	H. Boutet	101 Carew Bldg., Cincinnati, O.
New England.....	Oct. 10	Fuel Economy and Boiler Design.....	J. T. Anthony....	Wm. Cade, Jr.....	683 Atlantic Ave., Boston, Mass.
New York.....	Oct. 20	Education of Young Men to Fit Them for Promotion	F. W. Thomas....	Harry D. Vought..	95 Liberty St., New York .
Pittsburgh	Oct. 27	Annual Meeting; Smoker and Entertainment	.....	J. B. Anderson....	207 Penn Station, Pittsburgh, Pa.
Richmond	Oct. 16	Fire Box Efficiency.....	J. T. Anthony....	F. O. Robinson....	C. & O. Railway, Richmond, Va.
St. Louis	Oct. 13	The Ubiquitous Freight Car Question and Its Elusive Answer.....	E. H. DeGroot, Jr.	B. W. Frauenthal..	Union Station, St. Louis, Mo.
South'n & S'w'rn.	Nov. 16	Fire Prevention; Election of Officers.....	.....	A. J. Merrill.....	Box 1205, Atlanta, Ga.
Western	Oct. 16	Gears and Side Rods in Electric Locomotives	G. M. Eaton.....	Jos. W. Taylor....	1112 Karpen Bldg, Chicago.

power, eastern lines of the Canadian Pacific, succeeding J. T. Main, transferred.

P. O. WOOD, superintendent of locomotive performance of the St. Louis-San Francisco has been appointed assistant general superintendent of motive power with headquarters at Springfield, Mo.

GEORGE DURHAM, master mechanic of the Delaware, Lackawanna & Western at Scranton, Pa., has been appointed superintendent of motive power and cars of the Wheeling & Lake Erie with office at Brewster, O. Mr. Durham was born on October 10, 1875, at Pineville, Ky., and was educated in the common schools of his native town and later at Kentucky University, Lexington, Ky. He then entered the service of the Louisville & Nashville as a special apprentice and later served consecutively as a machinist, locomotive fireman, engineman, traveling engineer and general foreman until February 1, 1907. He was then appointed master mechanic of the Knoxville & Atlanta division with headquarters at Etowah, Tenn., remaining in that position until October 1, 1908, when he was made master mechanic of the same road at South Louisville, Ky. On April, 1911, he left that position and was appointed master mechanic of the Scranton, Bangor & Portland and the Syracuse & Utica divisions of the Delaware, Lackawanna & Western, which position he held until his appointment on September 15, 1916, as superintendent of motive power and cars of the Wheeling & Lake Erie.

G. Durham

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

J. A. BASINER has been appointed master mechanic of the Chicago, Aurora & DeKalb with headquarters at Aurora, Ill., to succeed William E. Jones.

B. W. BLUE, foreman mechanical department of the Louisville & Nashville at West Lexington, Ky., has been appointed acting assistant master mechanic at that point, succeeding R. E. McCuen, who has resigned to go into other business.

W. D. CHAFFEE, master mechanic of the New York Central at Watertown, N. Y., has been made master mechanic at Corning, N. Y., succeeding E. J. Snell, transferred.

A. E. DALES, district master mechanic of District 3, Manitoba division of the Canadian Pacific, at Brandon, has been appointed district master mechanic of District 4, Alberta division, at Edmonton, Alta., succeeding A. West, transferred.

A. K. GALLOWAY, whose appointment as general master mechanic of the northwest district of the Baltimore & Ohio and the Cincinnati, Hamilton & Dayton was announced in these columns last month, was born in St. Thomas, Ont., October 1, 1885. After completing a high school education, he entered the service of the Michigan Central in 1902 as a machinist apprentice. On completing his apprenticeship he remained in the service of that road until November 1, 1914, during this time being promoted to the position of roundhouse foreman and later to general foreman. He then left the service of the Michigan Central to become assistant master mechanic of the Baltimore & Ohio at Baltimore, Md., in which capacity he served until July 1, 1915, then being appointed master mechanic at Baltimore. Here he remained until his recent appointment as general master mechanic, above noted.

C. H. NORTON, master mechanic of the Erie at Avon, N. Y., has been transferred as master mechanic to Susquehanna, Pa.

JOHN L. SMITH, JR., whose appointment as master mechanic of the Pittsburgh & Shawmut at Brookville, Pa., was announced in these columns last month, was born in England, August 19, 1881. He received a high school education in this country, on completing which he entered the service of the Buffalo, Rochester & Pittsburgh in June, 1898. After serving his apprenticeship with this road he left railway service to enter the employ of the Westinghouse Electric & Mfg. Co., where he remained for several years. He then reentered railroad work as roundhouse foreman of the Baltimore & Ohio at Cleveland, Ohio, later leaving this road to enter the service of the Pittsburgh, Shawmut & Northern at St. Mary's, Pa. Early in 1912 he was appointed general roundhouse foreman of the Erie at Buffalo, N. Y., in which position he remained until his recent appointment as master mechanic of the Pittsburgh & Shawmut.

E. J. SNELL, master mechanic of the New York Central at Corning, N. Y., has been appointed master mechanic, with office at Watertown in place of W. D. Chaffee, who has been transferred.

F. G. WALLACE, general foreman of the Erie at Dunmore, Pa., has been appointed master mechanic at Avon, N. Y., succeeding C. H. Norton, who has been transferred.

A. WEST, district master mechanic of District 4, Alberta division of the Canadian Pacific, at Edmonton, has been appointed district master mechanic of District 3, Manitoba division with office at Brandon, Man., succeeding A. E. Dales, transferred.

W. T. WIECHERT has been appointed road foreman of engines on the Montana division of the Northern Pacific, with headquarters at Butte, Mont., succeeding William Dean, resigned.

CAR DEPARTMENT

R. KNORR, formerly foreman car department of the Erie at Hornell, N. Y., has been made foreman car department at Port Jervis, N. Y.

W. H. ORMAN has been appointed repair track foreman of the Canadian Pacific at Ogden, Alta., succeeding P. J. Siverton, transferred.

P. J. SIVERTON, repair track foreman of the Canadian Pacific at Ogden, Alta., has been appointed car foreman at Swift Current, Sask.

SHOP AND ENGINEHOUSE

H. A. AMY, locomotive foreman of the Canadian Pacific at Schreiber, Ont., has been appointed locomotive foreman at Cartier, Ont.

W. COOK, foreman boilermaker, National Transcontinental at Transcona, Man., has been appointed foreman boilermaker of the Grand Trunk Pacific at Edmonton, Alta.

R. S. DICKSON has been appointed locomotive foreman of the Canadian Pacific at Schreiber, Ont., succeeding H. A. Amy.

C. W. HINERMAN has been appointed assistant night roundhouse foreman of the Chesapeake & Ohio, at Clifton Forge, Va.

R. SUMMERVILLE has been appointed foreman boilermaker

of the National Transcontinental at Transcona, Man., succeeding W. Cook, who has been transferred to the Grand Trunk Pacific.

F. J. Topking, formerly roundhouse foreman of the Chesapeake & Ohio at Ronceverte, W. Va., has been appointed night roundhouse foreman at Clifton Forge, Va.

O. C. H. Waterman has been appointed enginehouse foreman of the Cleveland, Cincinnati, Chicago & St. Louis at Brightwood, Ind., succeeding J. D. Brandon.

PURCHASING AND STOREKEEPING

H. B. Akin, storekeeper of the Canadian Northern at Joliette, Que., has been appointed storekeeper of the Ontario division at Trenton, Ont., succeeding E. D. Toye, who has resigned on enlistment for military service in Europe.

Hugh Greenfield, who was recently appointed acting purchasing agent of the Duluth, Missabe & Northern, with headquarters at Duluth, Minn., succeeding Fred H. White, deceased, has been appointed purchasing agent.

Francis J. O'Connor, who has just been appointed general storekeeper of the Chicago, Milwaukee & St. Paul, with office at Milwaukee, Wis., was born August 18, 1874, at El Paso, Ill. After an elementary education he took a course at Green Bay Business College, leaving there early in 1891. In May of this same year he obtained employment with the Chicago, Milwaukee & St. Paul as stenographer and clerk in the store department at Green Bay, Wis., which position he held until November, 1894. From November, 1894, to July, 1895, he was storekeeper with headquarters at the same place, being then appointed clerk and foreman in the general store department at Milwaukee, Wis. From February, 1901, to November, 1902, he was chief clerk to the master mechanic of the Milwaukee shops and from November, 1902, to May, 1904, he was signal inspector and assistant signal engineer. In May, 1904, he was appointed chief clerk to the superintendent of motive power and held this position until appointed to the office of general storekeeper September 15.

F. J. O'Connor

J. F. Pratt has been appointed general storekeeper of the Great Northern, with office at St. Paul, Minn., succeeding John Opheim, transferred.

N. V. Porter, formerly chief clerk to the division storekeeper of the Wabash, with headquarters at Decatur, Ill., has been appointed division storekeeper on the line between Danville, Ill. and Toledo, Ohio, succeeding E. L. Ensel, resigned.

O. H. Wood has been appointed assistant purchasing agent of the Great Northern, with headquarters at Seattle, Wash., succeeding C. L. Bankson, resigned.

OBITUARY

W. A. Thomas, master mechanic, and R. D. Pond, roundhouse foreman of the Virginian Railway at Victoria, Va., were killed in a derailment on that road near Alberta, Va., September 20, while riding on the locomotive.

SUPPLY TRADE NOTES

B. H. Forsythe, formerly with the Hale & Kilborn Company, has entered the sales department of the Grip Nut Company, with offices in the McCormick building, Chicago, Ill.

A. T. Whiting, vice-president and secretary of the Whiting Foundry & Equipment Company, Harvey, Ill., died at his home in Chicago, September 12, after only a few days' illness.

George M. Judd has been elected secretary of the American Brake Shoe & Foundry Company, to succeed Henry C. Knox, resigned. Mr. Knox will remain as treasurer of the company.

Announcement has recently been made by the National Tube Company, Pittsburgh, Pa., of its plans for building a new plant at Gary, Ind., having a capacity of 500,000 tons a year.

Reuben C. Hallett, for many years active in railway supply circles, and for several years past connected with the Duntley Products Sales Company, Chicago, Ill., died at his home in Chicago, September 10.

Herman Voelker, assistant general foreman of the American Car & Foundry Company, has resigned to accept employment as general foreman of the wood car department of the Ralston Steel Car Company, Columbus, Ohio.

The Van Dorn Electric Tool Company, Cleveland, Ohio, has recently completed and moved into a new plant, which will make possible the doubling of the output of its line of portable electric tools. The buildings are of steel, brick and concrete construction, and are two and three stories in height.

H. E. Daniels, formerly western representative of the West Disinfecting Company, of New York City, has been appointed manager of the railroad and steamship department, with headquarters in the Railway Exchange, Chicago. Mr. Daniels was born in Boston, Mass., in 1873, where he received his early education and training. Upon graduating from school he took employment in the transportation department of the old Concord Railroad, now a part of the Southern division of the Boston & Maine. Later he entered the mechanical department of the New York, New Haven & Hartford as a fireman, and was later promoted to engineer. He was connected with this company nearly eight years, resigning to accept service with his present employer.

H. E. Daniels

The Magor Car Corporation, New York City, has been chartered in New York with a capital of 7,500 shares, 4,000 shares at $100 each, and 3,500 shares of no par value. It purposes to carry on business with $417,500. Its object is to furnish cars, railroad supplies, rails, structures, bridges, etc. The incorporators are Walter F. Purcell, George C. Carey, Bigelow Watts and O. Z. Whitehead.

To meet the growing demand for Armstrong tool holders a 50-ft. by 70-ft. steel and brick addition to its drop forging department is being built by the Armstrong Bros. Tool Company, Chicago. A new four-story building, 60 ft. by 130 ft., is also being erected. This is of reinforced concrete, fireproof

construction, and, in addition to providing a warehouse for finished stock, will house the shipping department and the offices.

D. R. McVay has been appointed railway sales representative of the Barrett Company, New York City, with headquarters at Cincinnati, Ohio.

W. E. Sharp has been elected president of the Grip Nut Company, Chicago, Ill., to succeed Edward R. Hibbard, who is retiring from business. Mr. Sharp began his railway career as an apprentice in the car department of the Erie in April, 1889. In October, 1892, he was promoted to the position of general foreman of the car and locomotive department of the same road, with headquarters at Chicago. He left this position in 1898 to accept service with the Armour Car Lines as assistant superintendent, and in April, 1901, he became superintendent of this line. In 1911 he resigned this position to enter the railway supply business, becoming vice-president of the Grip Nut Company, which office he continued to fill until his recent election to the presidency.

W. E. Sharp

Howard H. Hibbard has been elected vice-president of the Grip Nut Company, to succeed W. E. Sharp, who has been elected president of the company. Mr. Hibbard is the son of Edward R. Hibbard, who is retiring from the presidency of the company to make his home in California. Immediately on leaving school Howard H. Hibbard began his work in the company's plant at South Whitley, Ind. While employed here he has made a careful study of the details of the engineering and manufacturing of the devices which are handled by the company.

H. H. Hibbard

H. K. Ellyson has been appointed eastern representative of the railroad and steamship department of the West Disinfecting Company, making his headquarters at the home office, 12 East Forty-second street, New York City. Mr. Ellyson has been with this company for some time in various capacities.

The Union Metal Products Company, Chicago, has been granted sales rights to the grain tight car sill, which was described in the Railway Age Gazette, Mechanical Edition, February, 1914, page 81. This sill is in use on the Rock Island, Minneapolis & St. Louis, and the Denver & Rio Grande. A careful check on 4,000 cars equipped on the Rock Island, and which have been in service for 15 months, has shown that no claims for grain leakage have been paid, whereas, a check of 3,000 cars not so equipped has shown that claims were paid on 50 per cent of that number.

Henry B. Denker, one of the founders of the St. Charles Car Company, now a part of the American Car & Foundry Company, died at St. Charles, Mo., on August 30, aged 77 years. Mr. Denker was a native of Germany and came to this country when 19 years of age. He served in the Union army as captain during the Civil War, and then assisted in establishing the car plant which afterward was merged with the larger concern. After the merger he was made district manager.

The Railway & Mine Supply Company and the Kincaid Foundry & Machine Company, newly incorporated, have opened joint offices in the McCormick building, Chicago, Ill. The officers of the supply company are L. G. Binkley, president, and G. H. Peabody, vice-president; and of the foundry company, G. H. Peabody, president, and L. G. Binkley, vice-president. The Railway & Mine Supply Company will conduct a general jobbing business in railway and mine supplies. The Kincaid Foundry & Machine Company, which is the successor of the Hershfield & Piper Machine Company, formerly located at Taylorsville, Ill., is building a foundry at Kincaid, Ill. Kincaid is located on the Chicago & Illinois Midland about 90 miles from St. Louis, Mo. It is expected that the new foundry will be in operation some time in the month of December. The company will do a general foundry business in both gray and chilled iron, specializing in all kinds of castings for the railroad and mine business. G. H. Peabody, president of the Kincaid Foundry & Machine Company, was born in New York City in 1883. For several years he was engaged in the brokerage business in Wall street, following which he went to Chicago to open the first western branch office of the Lima Locomotive Corporation. He remained there as western manager of that company until 1914, when he returned to New York to become manager of the benzol department of the Lackawanna Steel Company. A year later he joined the sales force of the Griffin Wheel Company at Chicago, and remained with that organization until recently, when he resigned to accept the presidency of the Kincaid Foundry & Machine Company. L. G. Binkley, president of the Railway & Mine Supply Company, was born at Marion, Ill., in 1882. In 1904 he entered the employ of the Egyptian Powder Company, Alton,

L. G. Binkley

G. H. Peabody

Ill., manufacturers of explosives for coal mining purposes. He remained with this company for 13 years, rising to the office of vice-president. He was also sales manager of the Equitable Powder Company, Alton, Ill., when he resigned from both positions on April 1, 1916, to promote the organization of the companies with which Mr. Peabody and he are now connected.

The Duntley Company, Fisher building, Chicago, has been made the sole western distributor for the Hudson Ballata belting and other products of the Hudson Mechanical Rubber Company. The market for this class of belting has been materially increased on account of the war. Leather being in considerable demand by the warring nations has caused an increase in the price of leather belting of about 40 per cent.

W. D. Cloos, recently elected secretary and treasurer of the Lima Locomotive Corporation, Lima, Ohio, was born August 13, 1886, in Tioga County, Pa. After a preliminary education he entered Mansfield State Normal School, taking a four-year course from 1903 to 1907. Later he attended Mississippi State College, leaving in 1908. He was connected with the Franklin Railway Supply Company, Franklin, Pa., until his present appointment became effective.

Charles D. Ettinger, for 45 years connected with the Murphy Varnish Company and president of the Ohio Injector Company of Chicago, died September 4, after a brief illness. Mr. Ettinger was born at Wadsworth, Ohio, June 20, 1838, and during the civil war served in the hospital division of the quartermaster's department. After the war he engaged in the drug business in Findlay, Ohio. In 1871 he moved to Cleveland and took charge of the railroad department of the Murphy Varnish Company, removing to Chicago in January, 1884. Mr. Ettinger was secretary of this company and one of its directors. He partially retired from the activities of business a number of years ago, spending the greater part of his time in developing his farm at Midlothian, Ill.

Charles D. Ettinger

R. W. Cameron & Co., New York, who maintain a staff of engineers in Australia and New Zealand in connection with their export business, have found it necessary to recall R. W. Nichols of their Australian staff to New York in order to cope with the increasing business in railway supplies, machine tools, steel products, etc., and will have the advantage of the services of an engineer who thoroughly understands conditions in Australasia as well as the United States and Canada.

A new company has been formed with a capital of $400,000 to take over the defunct Nova Scotia Car Works, which were recently sold at auction for $157,000. The shareholders of the old company have been called to meet in Halifax, when it is expected that a new company will be organized with F. T. McCurdy, M. P., as president. The proposal for raising funds is that old shareholders be given the opportunity of one share of stock in the new company for every six shares held in the old concern.

Louis Sears has been appointed manager of railway sales of the Willard Storage Battery Company, Cleveland, Ohio, succeeding the late W. E. Ballantine. Mr. Sears has been with the Willard Storage Battery Company since April, 1908, remaining at the factory until January, 1910, at which time he went to the Chicago office where he remained until October, 1913. He was in the Cleveland office October, 1913, to March, 1915, and from March, 1915, to August, 1916, he was located in the New York office. Mr. Sears was transferred to the Cleveland office and received the appointment to his present position of manager of railway sales on August 1, 1916.

W. E. Greenwood has been appointed assistant manager of the railway sales department of the Texas Company, with headquarters at New York. Mr. Greenwood was born in New Orleans, La., and received his education at Roanoke College, Salem, Va. He entered railroad service in 1894 as clerk in the purchasing department of the Terminal Railroad Association of St. Louis. He left there January, 1898, to accept service in the purchasing department of the Missouri, Kansas & Texas at St. Louis, Mo., as voucher clerk, becoming chief clerk in 1901. He left railway service in April, 1912, to accept the position of eastern representative of the railway sales department of the Texas Company, where he remained until his recent appointment as assistant manager of the railway sales department.

W. E. Greenwood

The board of directors of the Lima Locomotive Corporation, Lima, Ohio, has elected W. E. Woodard vice-president, in charge of engineering and design, with offices at Lima, Ohio. Mr. Woodard was born in Utica, N. Y., in 1874, and attended the public schools at that place. He was graduated from Cornell University with the degree of mechanical engineer in 1896. For a time he was engaged in the laboratory and on road tests for the Baldwin Locomotive Works, but in 1897 entered the shop and drawing office of the Dickson Locomotive Works as elevation man. In 1900 he went with the Schenectady Locomotive Works, remaining with it and the American Locomotive Company, which succeeded it, up to the time of his present appointment. While with the American Locomotive Company he was employed in various capacities, including calculator, chief calculator, road testing work, foreman drawing office, assistant mechanical engineer, manager electric loco-

W. E. Woodard

motive and truck department, and finally as assistant chief engineer, having supervision over the general drawing office at Schenectady, N. Y. Mr. Woodard has patented a number of devices which are extensively used on modern heavy car and locomotive equipment, including the lateral motion driving box and axle, constant resistance engine truck, throttle pipe and lever, plate frame car trucks, car body height adjuster, lateral motion bolster and car and tender trucks. He is a member of the American Society of Mechanical Engineers and the Engineers of Eastern New York.

Edward Cumberland Fisher, formerly assistant manager of the Cooke and Rogers works of the American Locomotive Company, has been appointed manager of the Cooke works of that company at Paterson, N. J. He was born May 2, 1875, on a farm in Virginia. At the age of sixteen he entered the Virginia Mechanics' Institute, a night school of technology in Richmond, and at the same time entered the shops of the Tidewater & Western Railroad at Chester, Va., as a machinist apprentice. Shortly after completing his apprenticeship he accepted the position of general foreman of the Petersburgh Iron Works. When the firm failed about a year later he entered the employ of the Southern Railroad in its shops at Spencer, N. C., where he was soon made gang foreman. The following year he returned to Richmond as foreman of outside construction for the Richmond Iron Works, and shortly after was appointed instructor of mechanical drawing for the Chesapeake & Ohio in its apprentice school at Huntington, W. Va. This position he held until November 1, 1899, at which time he returned to Richmond as foreman for the Richmond Locomotive Works. After serving in various capacities, both in the drawing office and shops, he was transferred June 15, 1910, to Paterson, N. J., as superintendent of the Rogers works of the American Locomotive Company. In June, 1913, he was appointed assistant manager of the Cooke and Rogers works, and has now been appointed manager of the Cooke Works, as above noted.

Edward C. Fisher

The Edison Storage Battery Supply Company, Orange, N. J., announces the opening of its Los Angeles office on the fourth floor of the San Fernando building, corner Fourth and Main streets. James F. Rogan, who has been acting as local distributor of Edison storage batteries in Los Angeles, will become resident manager. This company also maintains two other offices on the Pacific Coast, one at 206 First street, San Francisco, in charge of District Manager E. M. Cutting, and another at 65 Columbia street, Seattle, under F. C. Gibson as resident manager.

D. E. Cain, western manager of the Dearborn Chemical Works, whose death at Denver, Colo., was recently announced, was born September, 1862, in Chicago, Ill., where he received his early education. He first entered the service of the Chicago & North Western, and in 1881 became connected with the Atchison, Topeka & Santa Fe as cashier at Osage City, Kan. From that time to July, 1902, he was consecutively on this same road as agent at Osage City and Leavenworth, Kan.; chief clerk to general superintendent of machinery at Topeka, Kan.; chief clerk to general manager, and assistant to general manager. From July, 1902, to April, 1905, he was general superintendent of the western grand division of the same road, with office at La Junta, Colo., and from April to June, 1905, he was general superintendent of the eastern grand division, with headquarters at Topeka, Kan. In June, 1905, he was appointed general manager of the Southwestern & Choctaw districts of the Chicago, Rock Island & Pacific, with office at Topeka, Kan., from which position he resigned in December, 1906, at the time that the Southwestern & Choctaw districts were placed under the jurisdiction of one general manager. He then became western manager of the Dearborn Chemical Works, having his headquarters at Denver, Colo. He was identified with this concern up to two years ago when ill health overtook him, and he found it necessary to retire from active business. He died in Chicago, the city of his birth, on August 31, 1916.

The Railway Motor Car Company of America, Chicago, Ill., has acquired a 13-acre plant at Hammond, Ind., fully equipped, in which it will at once begin the manufacture of cars. These cars will be made under patents owned by the company, and will be different in transmission and construction from any cars now in use. It is stated that the section car will constitute a self-contained power plant available for all sorts of track repairs. Later the company will produce unit passenger cars and locomotives, using the same principle of construction. F. A. Lester is vice-president and sales manager, and will have his headquarters in the Westminster building, Chicago, Ill.

Burton W. Mudge, president of Mudge & Co., Chicago, dealers in railway specialties, has also been elected president of the Safety First Manufacturing Company, Chicago, which will handle in western territory the asbestos and magnesia products of the Franklin Manufacturing Company, Franklin, Pa., together with additional specialties. Mr. Mudge was formerly connected with the operating departments of the Atchison, Topeka & Santa Fe, the Chicago & North Western, the Fort Worth & Denver and the Chicago, Rock Island & Pacific, from which latter road he resigned as assistant to the general manager in 1908 to engage in the railway supply business. In September, 1908, he started the firm of Burton W. Mudge & Brother, representing the Commonwealth Steel Company, of St. Louis, Mo. Later the company name was changed to Burton W. Mudge & Co., and finally to Mudge & Co. The specialties to be handled by the Safety First Manufacturing Company under the direction of Mr. Mudge include a parcel rack for passenger cars, a caboose stove, angle cock brackets for freight cars and a combustion chamber for oil burning shop furnaces.

B. W. Mudge

E. R. Rayburn, manager of the Chicago office of the Franklin Manufacturing Company will still continue to handle all of its waste packing products as heretofore, throughout the entire western part of the United States. The items to be handled by the Safety First Manufacturing Company, in connection with its association with the Franklin Manufacturing Company, will be their magnesia and asbestos lines, and the territory covered by such sales as made will

pass along the western boundaries of Minnesota, Iowa, Missouri and Arkansas, and run from the northwestern corner of Louisiana through New Orleans.

The Pollak Steel Company, manufacturers of car and locomotive axles, with plant located at Cincinnati, Ohio, announces that it has taken over the Willard Sons & Bell Company of South Chicago, Ill., and will make axles there as well as in Cincinnati. The capacity of the plant at Cincinnati recently has been doubled and extensive improvements have been made in it in the way of additional buildings and new machinery. About 1,500 men are now employed at this plant and about 500 men at the South Chicago plant. The combined forging and axle output of the two plants is estimated at 30,000 tons per month. Rodney D. Day, formerly general manager of sales for the William Tod Company, Youngstown, Ohio, has been appointed assistant to the vice-president of the company, with headquarters at Cincinnati. Mr. Day will be in full charge of all operations of both plants. Frank Dunbar, formerly western sales manager of Brown & Co., of Pittsburgh, Pa., and for many years connected with the mechanical department of the Missouri Pacific, has been appointed district manager with headquarters at South Chicago.

Frank Taylor Hyndman, superintendent of motive power and cars of the Wheeling & Lake Erie, has been appointed general manager of the Damascus Brake Beam Company, with office at Cleveland, Ohio, effective August 1, 1916, with full charge of plant operation and production. He was born on September 29, 1858, and began railway work in 1872 as machinist apprentice on the Central of New Jersey at Ashley, Pa., and from 1874 to 1877 was an apprentice in the shops of the Lehigh Valley at Wilkes-Barre; then, for about three years, was brakeman and fireman on the Central of New Jersey. From March to November, 1880, he was a machinist on the Atchison, Topeka & Santa Fe at Raton, New Mexico, and from March, 1881, to August, 1883, was machinist on the Pittsburgh & Western and with the Pittsburgh Locomotive Works, becoming an engineman on the Pittsburgh & Western in August, 1883. He remained in that position until September, 1895. when he was made trainmaster, and from April, 1896, to November, 1902, was master mechanic of the same road at Allegheny. He was then, for one month, master mechanic on the Baltimore & Ohio at Pittsburgh, and from December, 1902, to July, 1904, was master mechanic on the Buffalo, Rochester & Pittsburgh. In July, 1904, he was appointed superintendent of motive power of the same road at Dubois, Pa., and the following November went to the New York, New Haven & Hartford as general master mechanic at New Haven, Conn. He became mechanical superintendent of that road in May, 1906, resigning from that position on July 15, 1907, to enter the railway supply business. He was the Philadelphia representative of S. F. Bowser & Co., Inc., Fort Wayne, Ind., in July, 1913, when he was appointed superintendent of motive power and cars of the Wheeling & Lake Erie, which position he held until he was appointed general manager of the Damascus Brake Beam Company on August 1, as above noted.

F. T. Hyndman

CATALOGUES

Overhead Carrying Devices.—The New Jersey Foundry & Machine Company, New York, in catalogue 88, gives illustrations, descriptions, capacities and price lists of its line of overhead carrying devices. There are included tracking, trolleys, hoists, cranes, buckets, cars, etc.

Drills and Reamers.—Catalogue No. 15, issued by the Celfor Tool Company, Buchanan, Mich., is a 90-page book in which is listed the complete line of standard drills and reamers manufactured by this company. The catalogue also contains a list of drill chucks, drill sockets, lathe tool holders, tool bits, flue cutters and drill gages.

Locomotive Tanks.—The Locomotive Tank Company, New York, has issued a folder descriptive of the Acme-Flanged sectional locomotive tank. The distinguishing feature of the tank is that the top and bottom are formed from plates with edges turned toward the water space, thus eliminating all rivet holes through top and bottom.

Making Davis Wheels.—The American Steel Foundries have just issued an attractive 24-page booklet bearing the above title. In substance it describes a trip through the plant, viewing the processes of work on car wheels from the raw materials to the finished product. The pamphlet is not only interesting and informative, but is well printed, the illustrations being especially interesting.

Multiblade Fans.—The Clarage Fan Company, Kalamazoo, Mich., has recently issued catalogue No. 5, setting forth its line of multiblade fans for heating, ventilating and exhaust purposes. This is a 24-page booklet contained in a mailing folder; it is well illustrated and contains a number of capacity tables for the various size units. A more complete catalogue, No. 51, will be sent on requent.

Bulb Sections.—Under date of September 1, the Carnegie Steel Company, Pittsburgh, Pa., has issued a third edition of "Bulb Sections," a 17-page pamphlet, in which are catalogued the bulb angle and beam section, limited quantities of which are used in the car and shipbuilding trades. These sections are not carried in stock, but are furnished on order. The usual data concerning the dimensions and properties of the sections are given.

Passenger Car Trimmings.—Catalogue No. 200 recently issued by the Dayton Manufacturing Company, Dayton, Ohio, is 9 in. by 12 in. in size and contains 1,600 pages of illustrations of passenger car trimmings of all kinds. The book is a complete catalogue of passenger car hardware, lighting fixtures, water and dry closets, washstands and saloon fittings, vestibule and platform trimmings, brake handles, sash fixtures, basket racks, headlights, etc.

Train Lighting Batteries.—Bulletin 118, recently issued by the Edison Storage Battery Company, Orange, N. J., bears the title, Train Lighting Batteries, Edison. The booklet defines the various points of superiority of the Edison alkaline storage battery, touching upon its advantages under the heads of weight, maintenance and operation, life, temperature, efficiency and care. Several pages in the bulletin are devoted to a description of its manufacture.

Foundry Equipment and Appliances.—"A Model Foundry" is the title of booklet No. 125, which has recently been issued by the Whiting Foundry Equipment Company, Harvey, Ill. This gives in a general way the methods followed by this company in designing, equipping and conducting the initial operation of complete foundry plants for the manufacture of grey iron, brass, car wheel, pipe, converter steel and malleable castings. The book contains 36 pages and is profusely illustrated with photographs both of equipment details and various installations made by the Whiting Foundry Equipment Company.